NOTICE OF PROPOSED AMENDMENT (NPA) No 02/2006

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE AGENCY

AMENDING
DECISION NO. 2005/06/R OF THE EXECUTIVE DIRECTOR OF THE AGENCY
of 12 December 2005
on Certification Specifications, including airworthiness code and acceptable means of compliance, for large aeroplanes (« CS-25 »)

DOORS & MECHANICAL SYSTEMS

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A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Decision 2005/06/R of the Executive Director of 12 December 2005[1]. The scope of this rulemaking activity is outlined in ToR 25.010 and is described in more detail below.

2. The Agency is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[2] which are adopted as "Opinions" (Article 14(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 14(2)).

3. When developing rules, the Agency is bound to follow a structured process as required by Article 43(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as "The Rulemaking Procedure"[3].

4. This rulemaking activity is included in the Agency's rulemaking programme for 2006. It implements the rulemaking task 25.010: Doors and Mechanical Systems.

5. The text of this NPA was originally developed by the JAA D&F Steering Group and later developed by the Agency. It is submitted for consultation of all interested parties in accordance with Article 43 of the Basic Regulation and Articles 5(3) and 6 of the EASA rulemaking procedure.

II. Consultation

6. To achieve optimal consultation, the Agency is publishing the draft decision of the Executive Director on its internet site. As the content of this NPA was already agreed for adoption in the Joint Aviation Authorities (JAA) system and was the subject of a full worldwide consultation, the transitional arrangements of Article 15 of the EASA rulemaking procedure apply. This allows for a shorter consultation period of six weeks instead of the standard 3 months and exempts this proposal from the requirement to produce a full Regulatory Impact Assessment.

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[1] Decision No 2005/06/R of the Executive Director of the Agency of 12.12.2005 on certification specifications, including airworthiness code and acceptable means of compliance, for large aeroplanes (« CS-25 »).
[2] Regulation (EC) No 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency *(OJ L 240, 7.9.2002, p.1.)*
[3] Management Board Decision MB/7/03 from 27 June 2003 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("rulemaking procedure").

7. Comments on this proposal may be forwarded *(preferably by e-mail)*, using the attached comment form, to:

By e-mail: NPA@easa.eu.int

By correspondence: Process Support Unit
Rulemaking Directorate
EASA
Ref: NPA 02-2006
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be received by the Agency before Friday 21st April 2006. If received after this deadline they might not be treated. Comments may not be considered if the form provided for this purpose is not used.

III. Comment response document

8. All comments received in time will be responded to and incorporated in a comment response document (CRD). This may contain a list of all persons and/or organisations that have provided comments. The CRD will be widely available on the Agency's website.

IV. Content of the draft opinion

9. This NPA contains the following original JAA NPAs which have followed and completed the JAA consultation process:

   i) JAA NPA 25D-301 "Fuselage Doors";
   ii) JAA NPA 25DF-316 "Better Plan for Harmonisation – "Category 1" Items Mechanical Systems".

10. For each of the above JAA NPAs four different sections have been constructed in this EASA NPA as follows:

   I. Explanatory Note - Describing the development process and explaining the contents of the proposal.

   II. Proposals - The actual proposed amendments.

   III. Original JAA NPA justification - The proposals were already circulated for comments as a JAA NPA. This section contains the justification for the JAA NPA.

   IV. JAA NPA Comment Response Document - This section summarizes the comments made on the JAA NPA and the responses to those comments.

1. 11. The envisaged changes to Decision 2005/06/R are:

CS 25.729: Retracting mechanism
CS 25.773: Pilot compartment view
CS 25.783: Doors
CS 25.807: Emergency exits
CS 25.809: Emergency exit arrangement
CS 25.810: Emergency egress assist means and escape routes
CS 25.820: Lavatory doors
CS 25.851: Fire extinguishers
CS 25.1439: Protective breathing equipment
CS 25.1453: Protection of oxygen equipment from rupture

AMC 25.729: Retracting mechanism
AMC 25.773 Pilot compartment view
AMC 25.783: Fuselage doors
AMC 25.851(b): Fire extinguishers
AMC 25.1439(b)(5): Protective breathing equipment
AMC 25.1453: Protection of oxygen equipment from rupture.

B. JAA NPA 25D-301: Fuselage Doors (Final Version 2 January 2003)

I) Explanatory Note

(See also "A.I: General Explanatory Note")

1. SUMMARY

For practical reasons, the initial issue of CS-25 was based upon JAR-25 at Amendment 16. During the transposition of airworthiness JARs into Certification Specifications, however, the rulemaking activities under the JAA system where not stopped and significant rulemaking proposals have since been developed. In order to assure a smooth transition from JAA to EASA, the Agency has committed itself to continue as much as possible the JAA rulemaking activities. It has therefore included most of the JAA rulemaking programme into its own plans. This EASA NPA is a result of this commitment and this section is based on JAA NPA 25D-301 which was circulated for comments from 2 April 2002 till 2 July 2002.

This NPA proposes changes to the EASA Certification Specification for Large Aeroplanes (CS-25) by incorporating changes developed in co-operation with the US Federal Aviation Administration (FAA) and the Aviation Rulemaking Advisory Committee (ARAC). In summary, proposed changes are to:

CS 25.783: Doors
CS 25.807: Emergency exits
CS 25.809: Emergency exit arrangement
CS 25.810: Emergency egress assist means and escape routes

In addition, new paragraphs are introduced, namely:

CS 25.820: Lavatory doors
AMC 25.783: Fuselage doors

The scope of this proposal is to revise and reorganize the existing rules in CS-25 with the following objectives:

1. Clarify the existing design requirements for doors.
2. Define criteria for the door design requirements that are currently covered in the existing rules by general text.
3. Enhance safety levels by providing additional fail-safe requirements and detailed door design requirements, based on recommendations from the National Transportation Safety Board (NTSB) and the Air Transport Association (ATA) and through adopting current industry best practice.
4. Establish common requirements and language between the CS and FAR requirements

2. INTRODUCTION

The manufacturing, marketing and certification of large aeroplanes is increasingly an international endeavour. In order for manufacturers to export aeroplanes to other countries, the aeroplane must be designed to comply, not only with the airworthiness requirements of the State of Design, but also with the airworthiness requirements of the countries to which the aeroplane is to be exported.

In Europe, the airworthiness code for large aeroplanes is CS-25, which has been developed in a format similar to FAR Part 25. Many other countries have airworthiness codes that are aligned closely to CS-25 or to FAR Part 25, or they use these codes directly for their own certification purposes. Although CS-25 is very similar to FAR Part 25, there are differences in methodologies and criteria that often result in the need to address the same design objective with more than one kind of analysis or test in order to satisfy both CS-25 and FAR Part 25 requirements. These differences result in additional costs to the large aeroplane manufacturers and additional costs to the EASA, as well as to foreign authorities, that must continue to monitor compliance with a variety of different airworthiness codes.

In 1988, the JAA, in co-operation with the FAA and other organisations representing the European and U.S. aerospace industries, began a process to harmonise the airworthiness requirements of the European authorities with the airworthiness requirements of the United States. The objective was to achieve common requirements for the certification of large aeroplanes without a substantive change in the level of safety provided. Other airworthiness authorities such as Transport Canada have also participated in this process.

In 1992, the harmonisation effort was undertaken by the ARAC on the US side.

In 1996, an ARAC working group (General Structures Harmonisation Working Group), comprising of specialists from both industry and aviation regulatory authorities from Europe, the United States, and Canada was established to work on the door requirements of JAR/FAR 25, Subpart D: Design and Construction. A co-ordination was also established with the JAA Cabin Safety Steering Group to eliminate unnecessary and confusing duplication between the emergency exit requirements and the door design requirements.

The harmonisation effort progressed to a point where specific proposals were developed by the working group. These proposals were issued for public consultation through JAA NPA 25D-301: Fuselage Doors, in 2002. The FAA also published NPRM 03-01: Design Standards for Fuselage Doors on Transport Category Airplanes in January 2003 followed by publication of Amendment 25-114 effective as of June 2004. Other related issues were progressed through the FAA's Fast Track Harmonisation Procedure.

In the intervening time since the JAA NPA, these specific proposals have been applied on a voluntary basis for several JAA certification/validation programmes. An initial assessment of the impact and effectiveness of the extensively revised requirements and advisory material revealed several areas where further clarification was necessary. To address these, the JAA and European industry representatives of the original ARAC working group reconvened and the text was revised where considered necessary. However, due to the different timeframes for processing the proposals within the JAA/EASA and FAA, it was not possible to harmonize the final text prior to publication of FAA Amendment 25-114. Full harmonisation has therefore not been achieved, although in preparing this NPA, the EASA has reviewed FAA publications and aligned text where appropriate. The requirements and AMC contained in this NPA do not conflict with the rules published by the FAA or AC25.783-1A.

3. BACKGROUND

Following a major accident in 1974, which involved the opening of a fuselage door on a transport category aeroplane during flight, the FAA amended the applicable safety standards to provide a higher level of safety for fuselage doors. The FAA issued Amendment 25-54 to 14 CFR Part 25 (45 FR 60172, September 11, 1980), the objective of which was to provide a level of safety in doors consistent with the level of safety required for other critical systems on the aeroplane, such as primary flight controls. This was achieved by requiring redundancy and fail-safe features in the door operating systems, and by providing protection from anticipated human errors. The JAA accepted Amendment 25-54 in JAR-25 Change 10 (December 19, 1983).

In 1989, another wide-body transport category aeroplane lost a lower lobe cargo door, along with a portion of fuselage structure above the door, during flight. Because of this accident and other similar accidents, the FAA requested the ATA to form an industry task force to review door designs on transport category aeroplanes. This group was chartered to review the design and operation of doors on the current fleet of transport aeroplanes, and to recommend actions that would prevent any further inadvertent opening of outward opening doors. The group was also requested to review pertinent current regulations and advisory material, and to provide recommendations for necessary rule changes. The ATA provided its recommendations to the FAA in report entitled, "ATA Cargo Door Task Force Final Report," dated May 15, 1991.

As a result of its investigation of the aeroplane accident(s) associated with fuselage doors opening during flight, the NTSB also issued the following Safety Recommendations relating to doors on transport category aeroplanes, for consideration by the FAA:

Safety Recommendation A-89-092: Issue an airworthiness directive (AD) to require that the manual drive units and electrical actuators for Boeing 747 cargo doors have torque-limiting devices to ensure that the lock sectors, modified in accordance with the requirements of AD-88-12-04 [amendment 39-5934 (53 FR 18079, May 20, 1988)], cannot be overridden during mechanical or electrical operation of the latch cams.

Safety Recommendation A-89-093: Issue an airworthiness directive (AD) for non-plug cargo doors on all transport category aeroplanes requiring the installation of positive indicators to ground personnel and flight crews confirming the actual position of both the latch cams and locks, independently.

Safety Recommendation A-89-094: Require that fail-safe design considerations for non-plug cargo doors on present and future transport category aeroplanes account for conceivable human errors in addition to electrical and mechanical malfunctions.

Safety Recommendation A-92-21: Require that the electrical actuating systems for non-plug cargo doors on transport category aircraft provide for the removal of all electrical power from circuits on the door after closure (except for any indicating circuit power necessary to provide positive indication that the door is properly latched and locked) to eliminate the possibility of uncommanded actuator movements caused by wiring short circuits.

The FAA has responded to these safety recommendations by issuing various Airworthiness Directives, applicable to the current fleet of transport category aeroplanes, and requiring relevant modifications and inspections of the fuselage doors.

II) PROPOSALS

The text of the amendment is arranged to show deleted text, new text or a new paragraph as shown below:

1. ~~Text to be deleted is shown with a line through it.~~
2. New text to be inserted is highlighted with grey shading.
3. New paragraph or parts are not highlighted with grey shading, but are accompanied by the following box text:

Insert new paragraph / part *(Include N° and title)*, or replace existing paragraph/ part

4. * * * *
   Indicates that remaining text is unchanged in front of or following the reflected amendment.
   * * * *

Book 1
SUBPART D DESIGN AND CONSTRUCTION

Replace existing CS 25.783 with the following:

CS 25.783 Fuselage Doors

(a) *General*. This paragraph applies to fuselage doors, which includes all doors, hatches, openable windows, access panels, covers, etc., on the exterior of the fuselage that do not require the use of tools to open or close. This also applies to each door or hatch through a pressure bulkhead, including any bulkhead that is specifically designed to function as a secondary bulkhead under the prescribed failure conditions of CS-25. These doors must meet the requirements of this paragraph, taking into account both pressurised and unpressurised flight, and must be designed as follows:

(1) Each door must have means to safeguard against opening in flight as a result of mechanical failure, or failure of any single structural element.

(2) Each door that could be a hazard if it unlatches must be designed so that unlatching during pressurised and unpressurised flight from the fully closed, latched, and locked condition is extremely improbable. This must be shown by safety analysis.

(3) Each element of each door operating system must be designed or, where impracticable, distinctively and permanently marked, to minimise the probability of incorrect assembly and adjustment that could result in a malfunction.

(4) All sources of power that could initiate unlocking or unlatching of any door must be automatically isolated from the latching and locking systems prior to flight and it must not be possible to restore power to the door during flight.

(5) Each removable bolt, screw, nut, pin, or other removable fastener must meet the locking requirements of CS 25.607.

(6) Certain doors, as specified by CS 25.807(h), must also meet the applicable requirements of CS 25.809 through CS 25.812 for emergency exits.

(b) *Opening by persons*. There must be a means to safeguard each door against opening during flight due to inadvertent action by persons. In addition, design precautions must be taken to minimise the possibility for a person to open a door intentionally during flight. If these precautions include the use of auxiliary devices, those devices and their controlling systems must be designed so that:

(1) no single failure will prevent more than one exit from being opened, and

(2) failures that would prevent opening of any exit after landing must not be more probable than remote.

(c) *Pressurisation prevention means*. There must be a provision to prevent pressurisation of the aeroplane to an unsafe level if any door subject to pressurisation is not fully closed, latched, and locked.

(1) The provision must be designed to function after any single failure, or after any combination of failures not shown to be extremely improbable.

(2) Doors that meet the conditions described in sub-paragraph (h) of this paragraph are not required to have a dedicated pressurisation prevention means if, from every possible position of the door, it will remain open to the extent that it prevents pressurisation or safely close and latch as pressurisation takes place. This must also be shown with any single failure and malfunction except that:

(i) with failures or malfunctions in the latching mechanism, it need not latch after closing, and

(ii) with jamming as a result of mechanical failure or blocking debris, the door need not close and latch if it can be shown that the pressurisation loads on the jammed door or mechanism would not result in an unsafe condition.

(d) *Latching and locking.* The latching and locking mechanisms must be designed as follows:

(1) There must be a provision to latch each door.

(2) The latches and their operating mechanism must be designed so that, under all aeroplane flight and ground loading conditions, with the door latched, there is no force or torque tending to unlatch the latches. In addition, the latching system must include a means to secure the latches in the latched position. This means must be independent of the locking system.

(3) Each door subject to pressurisation, and for which the initial opening movement is not inward, must:

(i) have an individual lock for each latch;

(ii) have the lock located as close as practicable to the latch; and

(iii)be designed so that, during pressurised flight, no single failure in the locking system would prevent the locks from restraining the latches necessary to secure the door.

(4) Each door for which the initial opening movement is inward, and unlatching of the door could result in a hazard, must have a locking means to prevent the latches from becoming disengaged. The locking means must ensure sufficient latching to prevent opening of the door even with a single failure of the latching mechanism.

(5) It must not be possible to position the lock in the locked position if the latch and the latching mechanism are not in the latched position.

(6) It must not be possible to unlatch the latches with the locks in the locked position. Locks must be designed to withstand the limit loads resulting from:

(i) the maximum operator effort when the latches are operated manually;

(ii) the powered latch actuators, if installed; and

(iii)the relative motion between the latch and the structural counterpart.

(7) Each door for which unlatching would not result in a hazard is not required to have a locking mechanism meeting the requirements of sub-paragraphs (d)(3) through (d)(6) of this paragraph.

(8) Each door that could result in a hazard if not closed, must have means to prevent the

latches from being moved to the latched position unless the door is closed.

(e) *Warning, caution, and advisory indications.* Doors must be provided with the following indications:

(1) There must be a positive means to indicate at the door operator's station that all required operations to close, latch, and lock the door(s) have been completed.

(2) There must be a positive means, clearly visible from each operator station for each door that could be a hazard if unlatched, to indicate if the door is not fully closed, latched, and locked.

(3) There must be a visual means on the flight deck to signal the pilots if any door is not fully closed, latched, and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed, latched, and locked indication is improbable for:

(i) each door that is subject to pressurisation and for which the initial opening movement is not inward; or

(ii) each door that could be a hazard if unlatched.

(4) There must be an aural warning to the pilots prior to or during the initial portion of take-off roll if any door is not fully closed, latched, and locked, and its opening would prevent a safe take-off and return to landing.

(f) *Visual inspection provision.* Each door for which unlatching could be a hazard must have a provision for direct visual inspection to determine, without ambiguity, if the door is fully closed, latched, and locked. The provision must be permanent and discernible under operational lighting conditions, or by means of a flashlight or equivalent light source.

(g) *Certain maintenance doors, removable emergency exits, and access panels*. Some doors not normally opened except for maintenance purposes or emergency evacuation and some access panels need not comply with certain sub-paragraphs of this paragraph as follows:

(1) Access panels that are not subject to cabin pressurisation and would not be a hazard if open during flight need not comply with sub-paragraphs (a) through (f) of this paragraph, but must have a means to prevent inadvertent opening during flight.

(2) Inward-opening removable emergency exits that are not normally removed, except for maintenance purposes or emergency evacuation, and flight deck-openable windows need not comply with sub-paragraphs (c) and (f) of this paragraph.

(3) Maintenance doors that meet the conditions of sub-paragraph (h) of this paragraph, and for which a placard is provided limiting use to maintenance access, need not comply with sub-paragraphs (c) and (f) of this paragraph.

(h) *Doors that are not a hazard*. For the purposes of this paragraph, a door is considered not to be a hazard in the unlatched condition during flight, provided it can be shown to meet all of the following conditions:

(1) Doors in pressurised compartments would remain in the fully closed position if not restrained by the latches when subject to a pressure greater than 0,035 kg/cm² (0.5 psi). Opening by persons, either inadvertently or intentionally, need not be considered in making this determination.

(2) The door would remain inside the aeroplane or remain attached to the aeroplane if it opens either in pressurised or unpressurised portions of the flight. This determination must include the consideration of inadvertent and intentional opening by persons during either pressurised or unpressurised portions of the flight.

(3) The disengagement of the latches during flight would not allow depressurisation of the

cabin to an unsafe level. This safety assessment must include the physiological effects on the occupants.

(4) The open door during flight would not create aerodynamic interference that could preclude safe flight and landing.

(5) The aeroplane would meet the structural design requirements with the door open. This assessment must include the aeroelastic stability requirements of CS 25.629, as well as the strength requirements of Subpart C.

(6) The unlatching or opening of the door must not preclude safe flight and landing as a result of interaction with other systems or structures.

Amend CS 25.807 by adding new sub-paragraph (h) and (k) to read as follows:

CS 25.807 Emergency exits

* * * *

(g) [Reserved]

(h) *Other exits.* The following exits must also meet the applicable emergency exit requirements of CS 25.809 through 25.812, and must be readily accessible:

(1) Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits

(2) Any other floor-level door or exit that is accessible from the passenger compartment and is as large or larger than a Type II exit, but less than 1.17m (46 inches) wide.

(3) Any other ventral or tail passenger cone exit.

(i) [Reserved]

(j) [Reserved]

(k) Each passenger entry door in the side of the fuselage must qualify as a Type A, Type I, or Type II passenger emergency exit and must meet the requirements of CS 25.807 to CS 25.813 that apply to that type of emergency exit.

* * * *

Amend CS 25.809 by revising sub-paragraph (b), by adding a new sub-paragraph (b)(3), by revising sub-paragraphs (c) and by replacing sub-paragraph (f) to read as follows:

CS 25.809 Emergency exit arrangement

(b) * * * * readily accessible to the flight crew area. Inward opening doors may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. Each emergency exit must be capable…

* * * *

(1) * * * *

(2) * * * *

(3) Even though persons may be crowded against the door on the inside of the aeroplane.

(c) The means of opening emergency exits must be simple and obvious; ~~and~~ may not require exceptional effort; and must be arranged and marked so that it can be readily located and operated, even in darkness. Internal exit-opening means involving sequence operations (such as operation of two handles or latches or the release of safety catches) may be used for flight crew emergency exits if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use.

* * * *

(f) Each door must be located where persons using them will not be endangered by the propellers when appropriate operating procedures are used.

* * * *

Amend CS 25.810 by adding a new sub-paragraph (e) to read as follows:

CS 25.810 Emergency egress assist means and escape routes

* * * *

(e) If an integral stair is installed in a passenger entry door that is qualified as a passenger emergency exit, the stair must be designed so that, under the following conditions, the effectiveness of passenger emergency egress will not be impaired:

(1) The door, integral stair, and operating mechanism have been subjected to the inertia forces specified in CS 25.561(b)(3), acting separately relative to the surrounding structure.

(2) The aeroplane is in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear.

Add a new CS 25.820 to read as follows:

CS 25.820 Lavatory doors

All lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory. If a locking mechanism is installed, it must be capable of being unlocked from the outside without the aid of special tools.

CS-25 BOOK 2 - ACCEPTABLE MEANS OF COMPLIANCE (AMC)

Introduce a new Acceptable Means Of Compliance (AMC 25.783) as follows:

AMC 25.783
FUSELAGE DOORS

1. **PURPOSE**

This Acceptable Means Of Compliance, which is similar to the FAA Advisory Circular AC 25.783-1A describes an acceptable means for showing compliance with the requirements of CS-25 dealing with the certification of fuselage external doors and hatches.

The means of compliance described in this document is intended to provide guidance to supplement the engineering and operational judgement that must form the basis of any compliance findings relative to the structural and functional safety standards for doors and their operating systems

This document describes an acceptable means, but not the only means, for demonstrating compliance with the requirements. Terms such as "shall" and "must" are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described in this document is used.

2. RELATED CS PARAGRAPHS The contents of this AMC are considered by the EASA in determining compliance of doors with the safety requirements of CS 25.783. Other related paragraphs are:

CS 25.571, "Damage-tolerance and fatigue evaluation of structure"
CS 25.607, "Fasteners"
CS 25.703, "Take-off warning system"
CS 25.809, "Emergency exit arrangement"

3. DEFINITIONS OF TERMS

Inconsistent or inaccurate use of terms may lead to the installation of doors and hatches that do not fully meet the safety objectives of the regulations. To ensure that such installations fully comply with the regulations, the following definitions should be used when showing compliance with CS 25.783:

a. *"Closed"* means that the door has been placed within the door frame in such a position that the latches can be operated to the "latched" condition. *"Fully closed"* means that the door is placed within the door frame in the position it will occupy when the latches are in the latched condition.

b. *"Door"* includes all doors, hatches, openable windows, access panels, covers, etc. on the exterior of the fuselage which do not require the use of tools to open or close. This also includes each door or hatch through a pressure bulkhead including any bulkhead that is specifically designed to function as a secondary bulkhead under the prescribed failure conditions of CS-25.

c. *"Door operator's station"* means the location(s) where the door closing, latching and locking operations are performed.

d. *"Emergency exit"* is an exit designated for use in an emergency evacuation.

e. *"Exit"* is a door designed to allow egress from the aeroplane.

f. *"Flight"* refers to that period of time from start of the take-off roll until the aeroplane comes to rest after landing.

g. *"Inadvertent action by persons"* means an act committed without forethought, consideration or consultation.

h. *"Initial inward opening movement"*. In order for a door design to be classified as having an inward initial opening movement, the provisions provided to guide the door inward must have:

i) sufficient rigidity and strength to fulfil their function with a pressure of at least 0,14 kg/cm² (2 psi) applied to the door.
ii) sufficient range to maintain the closing component from the pressurisation load until the loss of cabin air past the partially open door is such that cabin pressurisation greater than 0.035 kg/cm² (0.5 psi) cannot be maintained.
iii) design features that ensure that adjustment / wear of the door stops, guides, rollers or associated mechanism cannot negate the means provided to move the door inwards.

i. *"Initial opening movement,"* refers to that door movement caused by operation of a handle or other door control mechanism, which is required to place the door in a position free of structure that would interfere with continued opening of the door.

j. *"Inward"* means having a directional component of movement that is inward with respect to the mean (pressure) plane of the body cut-out.

k. *"Latched"* means the latches are engaged with their structural counterparts and held in position by the latch operating mechanism.

l. *"Latches"* are movable mechanical elements that, when engaged, prevent the door from opening.

m. *"Latching system"* means the latch operating system and the latches.

n. *"Locked"* means the locks are engaged and held in position by the lock operating mechanism.

o. *"Locking system"* means the lock operating system and the locks.

p. *"Locks"* are mechanical elements in addition to the latch operating mechanism that monitor the latch positions, and when engaged, prevent latches from becoming disengaged.

q. *"Stops"* are fixed structural elements on the door and door frame that, when in contact with each other, limit the directions in which the door is free to move.

4. BACKGROUND

4.1 History of incidents and accidents

There is a history of incidents and accidents in which doors, fitted in pressurised aeroplanes, have opened during pressurised and unpressurised flight. Some of these inadvertent openings have resulted in fatal crashes. After one fatal accident that occurred in 1974, the FAA and industry representatives formed a design review team to examine the current regulatory requirements for doors to determine if those regulations were adequate to ensure safety. The team's review and eventual recommendations led to the FAA issuing Amendment 25-54 to 14 CFR part 25 in 1980, that was adopted by the JAA in JAR-25 Change 10 in 1983, which significantly improved the safety standards for doors installed on large aeroplanes. Included as part of JAR-25 Change 10 (Amendment 25-54) was JAR 25.783, "Doors," which provides the airworthiness standards for doors installed on large aeroplanes.

Although there have been additional minor revisions to JAR 25.783 subsequent to the issuance of Change 10 (Amendment 25-54), the safety standards for doors have remained essentially the same since 1980.

4.2 Continuing safety problems

In spite of the improved standards brought about in 1980, there have continued to be safety problems, especially with regard to cargo doors. Cargo doors are often operated by persons having little formal instruction in their operation. Sometimes the operator is required to carry out several actions in sequence to complete the door opening and closing operations. Failure to complete all sequences during closure can have serious consequences. Service history shows that several incidents of doors opening during flight have been attributed to the failure of the operator to complete the door closure and locking sequence. Other incidents have been attributable to incorrect adjustment of the door mechanism, or failure of a vital part.

4.3 Indication to the flight crew

Experience also has shown that, in some cases, the flight deck indication system has not been reliable. In other instances, the door indication system was verified to be indicating correctly, but the flight crew, for unknown reasons, was not alerted to the unsafe condition. A reliable indication of door status on the flight deck is particularly important on aeroplanes used in operations where the flight crew does not have an independent means readily available to verify that the doors are properly secured.

4.4 Large cargo doors as basic airframe structure.

On some aeroplanes, large cargo doors form part of the basic fuselage structure, so that, unless the door is properly closed and latched, the basic airframe structure is unable to carry the design aerodynamic and inertial loads. Large cargo doors also have the potential for creating control problems when an open door acts as an aerodynamic surface. In such cases, failure to secure the door properly could have catastrophic results, even when the aeroplane is unpressurised.

4.5 NTSB (USA) recommendations.

After two accidents occurred in 1989 due to the failure of cargo doors on transport category aeroplanes, the FAA chartered the Air Transport Association (ATA) of America to study the door design and operational issues again for the purpose of recommending improvements. The ATA concluded its study in 1991 and made recommendations to the FAA for improving the design standards of doors. Those recommendations together with additional recommendations from the National Transportation Safety Board (NTSB) were considered in the development of improved standards for doors adopted by Amendment 25-114.

5. DISCUSSION OF THE CURRENT REQUIREMENTS

Service history has shown that to prevent doors from becoming a hazard by opening in flight, it is necessary to provide multiple layers of protection against failures, malfunctions, and human error. Paragraph 25.783 addresses these multiple layers of protection by requiring:

- a latching system;
- a locking system;
- indication systems;
- a pressure prevention means.

These features provide a high degree of tolerance to failures, malfunctions, and human error. Paragraph CS 25.783 intends that the latching system be designed so that it is inherently or specifically restrained from being back-driven from the latches; but even so, the latches are designed to eliminate, as much as possible, all forces from the latch side that would tend to unlatch the latches. In addition to these features that prevent the latches from inadvertently opening, a separate locking system is required for doors that could be a hazard if they become unlatched. Notwithstanding these safety features, it could still be possible for the door operator to make errors in closing the door, or for mechanical failures to occur during or after closing; therefore, an indicating system is required that will signal to the flight crew if the door is not fully closed, latched, and locked. However, since it is still possible for the indication to be missed or unheeded, a separate system is required that prevents pressurisation of the aeroplane to an unsafe level if the door is not fully closed, latched, and locked.

The following material restates the requirements of CS 25.783 *in italicised text* and, immediately following, provides a discussion of acceptable compliance criteria.

CS 25.783(a) General Design Considerations

This paragraph applies to fuselage doors, which includes all doors, hatches, openable windows, access panels, covers, etc., on the exterior of the fuselage that do not require the use of tools to open or close. This also applies to each door or hatch through a pressure bulkhead, including any bulkhead that is specifically designed to function as a secondary bulkhead under the prescribed failure conditions of CS-25. These doors must meet the requirements of this paragraph, taking into account both pressurised and unpressurised flight, and must be designed as follows:

(a)(1) Each door must have means to safeguard against opening in flight as a result of mechanical failure, or failure of any single structural element.

Failures that should be considered when safeguarding the door against opening as a result of mechanical failure or failure of any single structural element include those caused by:

- wear;
- excessive backlash;
- excessive friction;
- jamming;
- incorrect assembly;
- incorrect adjustment;
- parts becoming loose, disconnected, or unfastened;
- parts breaking, fracturing, bending or flexing beyond the extent intended.

(a)(2) Each door that could be a hazard if it unlatches must be designed so that unlatching during pressurised and unpressurised flight from the fully closed, latched, and locked condition is extremely improbable. This must be shown by safety analysis .

All doors should incorporate features in the latching mechanism that provide a positive means to prevent the door from opening as a result of such things as:

- vibrations;
- structural loads and deflections;
- positive and negative pressure loads, positive and negative 'g' loads;
- aerodynamic loads etc.

The means should be effective throughout the approved operating envelope of the aeroplane including the unpressurised portions of flight.

The safety assessment required by this regulation may be a qualitative or quantitative analysis, or a combination as appropriate to the design. In evaluating a failure condition that results in total failure or inadvertent opening of the door, all contributing events should be considered, including:

- failure of the door and door supporting structure;
- flexibility in structures and linkages;
- failure of the operating system;
- erroneous signals from the door indication systems;
- likely errors in operating and maintaining the door.

(a)(3) Each element of each door operating system must be designed or, where impracticable, distinctively and permanently marked, to minimise the probability of incorrect assembly and adjustment that could result in a malfunction.

Experience has shown that the level of protection against mechanical failure can be significantly improved by careful attention to detail design. The following points should therefore be taken into account:

(a) To minimise the risk of incorrect assembly and adjustment, parts should be designed to prevent incorrect assembly if, as a result of such incorrect assembly, door functioning would be adversely affected. "Adverse effects" could be such things as preventing or impeding the opening of the door during an emergency, or reducing the capability of the door to remain closed. If such designs are impracticable and marking is used instead, the marking should remain clearly identifiable during service. In this respect, markings could be made using material such as permanent ink, provided it is resistant to typical solvents, lubricants, and other materials used in normal maintenance operations.

(b) To minimise the risk of the door operating mechanism being incorrectly adjusted in service, adjustment points that are intended for "in-service" use only should be clearly identified, and limited to a minimum number consistent with adequate adjustment capability. Any points provided solely to facilitate adjustment at the initial build and not intended for subsequent use, should be made non-adjustable after initial build, or should be highlighted in the maintenance manual as a part of the door mechanism that is not intended to be adjusted.

(a)(4) All sources of power that could initiate unlocking or unlatching of each door must be automatically isolated from the latching and locking systems prior to flight and it must not be possible to restore power to them during flight.

For doors that use electrical, hydraulic, or pneumatic power to initiate unlocking or unlatching, those power sources must be automatically isolated from the latching and locking systems before flight, and it should not be possible to restore power to them during flight. It is particularly important for doors with powered latches or locks to have all power removed that could power these systems or that could energise control circuits to these systems in the event of electrical short circuits. This does not include power to the door indicating system, auxiliary securing devices if installed, or other systems not related to door operation. Power to those systems should not be sufficient to cause unlocking or unlatching unless each failure condition that could result in energising the latching and locking systems is extremely improbable.

(a)(5) Each removable bolt, screw, nut, pin, or other removable fastener must meet the locking requirements of CS 25.607. [Fasteners]

Refer to AMC 25.607 for guidance on complying with CS 25.607.

(a)(6) Certain fuselage doors, as specified by 25.807(h), must also meet the applicable requirements of CS 25.809 through 25.812 for emergency exits.

CS 25.783(b) Opening by persons

There must be means to safeguard each door against opening during flight due to inadvertent action by persons.

The door should have inherent design features that achieve this objective. It is not considered acceptable to rely solely on cabin pressure to prevent inadvertent opening of doors during flight, because there have been instances where doors have opened during unpressurised flight, such as during landing. Therefore all doors should incorporate features to prevent the door from being opened inadvertently by persons on board.

In addition, design precautions must be taken to minimise the possibility for a person to open a door intentionally during flight. If these precautions include the use of auxiliary devices, those devices and their controlling systems must be designed so that:

(i) no single failure will prevent more than one exit from being opened, and

(ii) failures that would prevent opening of any exit after landing are improbable.

The intentional opening of a door by persons on board while the aeroplane is in flight should be considered. This rule is intended to protect the aircraft and passengers but not necessarily the person who intentionally tries to open the door. Suitable design precautions should therefore be taken; however, the precautions should not compromise the ability to open an emergency exit in an emergency evacuation. The following precautions should be considered:

(a) <u>For doors in pressurised compartments</u>: it should not normally be possible to open the door when the compartment differential pressure is above 0.14 kg/cm² (2 psi). The ability to open the door will depend on the door operating mechanism and the handle design, location and operating force. Operating forces in excess of 136 kg (300 pounds) should be considered sufficient to prevent the door from being opened. During approach, take-off and landing when the compartment differential pressure is lower, it is recognised that intentional opening may be possible; however, these phases are brief and all passengers are expected to be seated with seat belts fastened. Nevertheless flight experience has shown that cabin staff may cycle door handles during take-off in an attempt to ensure that the door is closed, resulting in door openings in flight. For hazardous doors CS 25.783(e)(2) intends to provide a positive means to indicate to the door operator after closure of the door on the ground, that the door is not properly closed, latched and locked. CS 25.783(e)(2) will minimise, but can not prevent the deliberate cycling of the door handle by the cabin staff during take-off.

(b) For doors that cannot meet the guidance of (a) above, and for doors in non-pressurised aeroplanes: The use of auxiliary devices (for example, a speed-activated or barometrically-activated means) to safeguard the door from opening in flight should be considered. The need for such auxiliary devices should depend upon the consequences to the aeroplane and other occupants if the door is opened in flight.

(c) Auxiliary devices installed on emergency exits: The failure of an auxiliary device should normally result in an unsecured position of the device. Failures of an auxiliary device that would prevent opening of the exit after landing should not be more probable than Remote ($\leq 1x10^{-5}$). Where auxiliary devices are controlled by a central system or other more complex systems, a single failure criterion for opening may not be sufficient. The criteria for failure of the auxiliary device to open after landing should include consideration of single failures and all failure conditions that are more probable than remote. In the assessment of single failures, no credit should be given to dormant functions.

CS 25.783(c) Pressurisation prevention means

There must be a provision to prevent pressurisation of the aeroplane to an unsafe level if any door subject to pressurisation is not fully closed, latched, and locked.

(c)(1) The provision must be designed to function after any single failure, or after any combination of failures not shown to be extremely improbable.

(a) The provisions for preventing pressurisation must monitor the closed, latched and locked condition of the door. If more than one lock system is used, each lock system must be monitored. Examples of such provisions are vent panels and pressurisation inhibiting circuits. Pressurisation to an unsafe level is considered to be prevented when the pressure is kept below 0,035 kg/cm² (1/2 psi). These systems are not intended to function to depressurise the aeroplane once the fully closed latched and locked condition is established and pressurisation is initiated.

(b) If a vent panel is used, it should be designed so that, in normal operation or with a single failure in the operating linkage, the vent panel cannot be closed until the door is latched and locked. The vent panel linkage should monitor the locked condition of each door lock system.

(c) If automatic control of the cabin pressurisation system is used as a means to prevent pressurisation, the control system should monitor each lock. Because inadvertent depressurisation at altitude can be hazardous to the occupants, this control system should be considered in showing compliance with the applicable pressurisation system reliability requirements. Normally, such systems should be automatically disconnected from the aeroplane's pressurisation system after the aeroplane is airborne, provided no prior unsafe condition was detected.

(d) It should not be possible to override the pressurisation prevention system unless a procedure is defined in the Master Minimum Equipment List (MMEL) that confirms a fully closed, latched and locked condition. In order to prevent the override procedure from becoming routine, the override condition should not be achievable by actions solely on the flight deck and should be automatically reset at each door operational cycle.

(c)(2) Doors that meet the conditions described in sub-paragraph (h) of this paragraph are not required to have a dedicated pressurisation prevention means if, from every possible position of the door, it will remain open to the extent that it prevents pressurisation or safely close and latch as pressurisation takes place. This must also be shown with any single failure and malfunction except that:

(i) with failures or malfunctions in the latching mechanism, it need not latch after closing, and

(ii) with jamming as a result of mechanical failure or blocking debris, the door need not close and latch if it can be shown that the pressurisation loads on the jammed door or mechanism would not result in an unsafe condition.

As specified in CS 25.783(d)(7), each door for which unlatching would not result in a hazard is not required to have a locking mechanism; those doors also may not be required to have a dedicated pressurisation prevention means. However, this should be determined by demonstrating that an unsafe level of pressurisation cannot be achieved for each position that the door may take during closure, including those positions that may result from single failures or jams.

- Excluding jamming and excluding failures and malfunctions in the latching system, for every possible position of the door, it must either remain open to the extent that it prevents pressurisation, or safely close and latch as pressurisation takes place;

- With single failures of the latching system or malfunctions in the latching system the door may not necessarily be capable of latching, but it should either remain open to the extent that it prevents pressurisation, or safely move to the closed position as pressurisation takes place; and

- With jamming as a result of mechanical failure in the latching system or blocking debris, the pressurisation loads on the jammed door or mechanism may not result in damage to the door or airframe that could be detrimental to safe flight (both the immediate flight or future flights). In this regard, consideration should be given to jams or non-frangible debris that could hold the door open just enough to still allow pressurisation, and then break loose in flight after full pressurisation is reached.

CS 25.783(d) Latching and locking

The latching and locking mechanisms must be designed as follows:

(d)(1) There must be a provision to latch each door.

(a) The definitions of latches and locks are redefined in Chapter 3 [Definitions of Terms], particularly in regard to mechanical and structural elements of inward-opening plug doors. In this regard, fixed stops are not considered latches. The movable elements that hold the door in position relative to the fixed stops are considered latches. These movable elements prevent the door from opening and will support some loads in certain flight conditions, particularly when the aeroplane is unpressurised.

(b) For all doors, sub-paragraph 25.783(d)(2) requires that the latching system employ a securing means other than the locking system. The separate locking system may not be necessary for certain doors with an initial inward movement (see CS 25.783(d)(4)).

(d)(2) The latches and their operating mechanism must be designed so that, under all aeroplane flight and ground loading conditions, with the door latched, there is no force or torque tending to unlatch the latches. In addition, the latching system must include a means to secure the latches in the latched position. This means must be independent of the locking system.

The latches of doors for which the initial opening movement is outward are typically subject to vibrations; structural loads and deflections; positive and negative pressure loads; positive and negative ‘g’ loads; aerodynamic loads; etc. The latches of doors for which the initial opening movement is inward typically share some of these same types of loads with fixed stops. Doors for which the initial opening movement is inward tend to be resistant to opening when the aircraft is pressurised since a component of the pressure load tends to hold the door closed.

(a) <u>Latch design</u>. The design of the latch should be such that with the latch disconnected from its operating mechanism, the net reaction forces on the latch should not tend to unlatch the latch during both pressurised and unpressurised flight throughout the approved flight envelope. The effects of possible friction in resisting the forces on the latch should be ignored when considering reaction forces tending to unlatch the door. The effects of distortion of the latch and corresponding structural attachments should be taken into account in this determination. Any latch element for which ‘g’ loads could result in an unlatching force should be designed to minimise such forces.

(b) <u>Latch securing means</u>. Even though the principal back-driving forces should be eliminated by design, it is recognised that there may still be ratcheting forces that could progressively move the latches to the unlatched position. Therefore, each latch should be positively secured in the latched position by its operating mechanism, which should be effective throughout the approved flight envelope. The location of the operating system securing means will depend on the rigidity of the system and the tendency for any forces (such as ratcheting, etc.) at one latch to unlatch other latches.

(c) <u>Overcenter features in the latching mechanism</u> are considered to be an acceptable securing means, provided that an effective retaining feature that functions automatically to prevent back-driving is incorporated. If the design of the latch is such that it could be subject to ratcheting loads which might tend to unlatch it, the securing means should be adequate to resist such loads.

(d) <u>Back-driving effect of switches.</u> In those designs that use the latch to operate an electrical switch, any back-driving effect of the switch on the latch is permissible, provided that the extent of any possible movement of the switch

- is insufficient to unlatch it; and
- will not result in the latch being subjected to any other force or torque tending to unlatch it.

(e) The latch securing means must be independent of the locking means. However, the latching and locking functions may be fulfilled by a single operating means, provided that it is not possible to back-drive the locks via the latch mechanism when the door locks are engaged with the latch mechanism.

(d)(3) Each door subject to pressurisation, and for which the initial opening movement is not inward must:

(i) have an individual lock for each latch;
(ii) have the lock located as close as practicable to the latch; and
(iii) be designed so that during pressurised flight, no single failure in the locking system would prevent the locks from restraining the latches necessary to secure the door.

(a) To safeguard doors subject to pressurisation and for which the initial opening movement is not inward, each latch must have an individual lock. The lock should directly lock the latch. In this regard, the lock should be located directly at the latch to ensure that, in the event of a single failure in the latch operating mechanism, the lock would continue to restrain the latch in the latched position. Even in those cases where the lock cannot be located directly at the latch, the same objective should be achieved. In some cases, a pair of integrally-connected latches may be treated as a single latch with respect to the requirement for a lock provided that:

1) the lock reliably monitors the position of at least one of the load carrying elements of the latch, and
2) with any one latch element missing, the aeroplane can meet the full requirements of CS-25 as they apply to the unfailed aeroplane, and
3) with the pair disengaged, the aeroplane can achieve safe flight and landing, and meet the damage tolerance requirements of CS 25.571[Damage-tolerance and fatigue evaluation of structure].

(b) In some designs more latches are provided than necessary to meet the minimum design requirements. The single failure requirement for the locking system is intended to ensure that the number and combination of latches necessary to secure the door will remain restrained by the locking mechanism. Only those latches needed to meet the minimum design requirements need to remain restrained after the single failure.

(c) In meeting this requirement, the indirect locking provided through the latch system by the locks at other latches may be considered. In this case, the locking system and the latching system between the locked latch and the unlocked latch should be designed to withstand the maximum design loads discussed in sub-paragraph d.(6) of this AMC, below, as appropriate to pressurised flight.

(d)(4) Each door for which the initial opening movement is inward, and unlatching of the door could result in a hazard, must have a locking means to prevent the latches from becoming disengaged. The locking means must ensure sufficient latching to prevent opening of the door even with a single failure in the latching mechanism.

On these doors, the locking means should monitor the latch securing means, but need not directly monitor and lock each latch. Additionally, the locking means could be located such that all latches are locked by locking the latching mechanism. With any single failure in the latching mechanism, the means must still lock a sufficient number of latches to ensure that the door remains safely latched.

(d)(5) It must not be possible to position the lock in the locked position if the latch and the latching mechanism are not in the latched position.

The lock should be an effective monitor of the position of the latch such that, if any latch is unlatched, the complete locking system cannot be moved to the locked position. Although an overcenter feature may be an adequate means of securing the latching mechanism, it is not considered to be the locking means for the latches.

(d)(6) It must not be possible to unlatch the latches with the locks in the locked position. Locks must be designed to withstand the limit loads resulting from:

(i) the maximum operator effort when the latches are operated manually;
(ii) the powered latch actuators, if installed; and
(iii) the relative motion between the latch and the structural counterpart.

Although the locks are not the primary means of keeping the latches engaged, they must have sufficient strength to withstand any loads likely to be imposed during all approved modes of door operation. The operating handle loads on manually-operated doors should be based on a rational human factors evaluation. However, the application of forces on the handle in excess of 136 kg (300 pounds) need not be considered. The loads imposed by the normal powered latch actuators are generally predictable; however, loads imposed by alternate drive systems are not. For this reason the locks should have sufficient strength to react the stall forces of the latch drive system. Load-limiting devices should be installed in any alternate drive system for the latches in order to protect the latches and the locks from overload conditions. If the design of the latch is such that it could be subject to ratcheting loads which might tend to unlatch it, the locks should be adequate to resist such loads with the latch operating system disconnected from the latch.

(d)(7) Each door for which unlatching would not result in a hazard is not required to have a locking mechanism meeting the requirements of sub-paragraph (d)(3) through (d)(6) of this paragraph.

See sub-paragraph CS 25.783(h) of this AMC, below, for a description of doors for which unlatching is considered not to result in a safety hazard.

(d)(8) Each door that could result in a hazard if not closed must have means to prevent the latches from being moved to the latched position unless the door is closed.

Existing door designs may incorporate features that prevent the latches from moving to the latched position if the door is not closed. The importance of such a feature is that it prevents the latched and locked functions from being completed when the door is not closed, while at the same time providing a safe door impression to the door operator. In that case the only safeguard against dispatch with an open door may depend on one (door in aperture) switch in the indication system. For door security however it is good basic design philosophy not to rely on the indication system, but to provide independent integrity in the closing, latching and locking functions.

CS25.783(e) Warning, caution and advisory indications

Doors must be provided with the following indications:

(e)(1) There must be a positive means to indicate at each door operator's station that all required operations to close, latch, and lock the door(s) have been completed.

In order to minimise the probability of incomplete door operations, it should be possible to perform all operations for each door at one station. If there is more than one operator's station for a single door, appropriate indications should be provided at each station. The positive means to indicate at the door operator's station that all required operations have been completed are such things as final handle positions or indicating lights. This requirement is not intended to preclude or require a single station for multiple doors.

(e)(2) There must be a positive means, clearly visible from each operator station for each door that could be a hazard if unlatched, to indicate if the door is not fully closed, latched, and locked.

A single indication that directly monitors the door in the closed, latched and locked conditions should be provided unless the door operator has a visual indication that the door is fully closed latched and locked. This indication should be obvious to the door operator. For example, a vent door or indicator light that monitors the door locks and is located at the operator's station may be sufficient. In case of an indicator light, it should not be less reliable than the visual means in the cockpit as required per CS 25.783(e)(3). Preferably the same sensors should be used for both indications in order to prevent any discrepancy between the indications.

(e)(3) There must be a visual means on the flight deck to signal the pilots if any door is not fully closed, latched, and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed, latched, and locked indication is improbable for:

(i) each door that is subject to pressurisation and for which the initial opening movement is not inward, or
(ii) each door that could be a hazard if unlatched.

The visual means may be a simple amber light or it may need to be a red warning light tied to the master warning system depending on the criticality of the door. The door closed, latched and locked functions must be monitored, but only one indicator is needed to signal that the door is in the closed, latched and locked condition. Indications should be reliable to ensure they remain credible. The probability of erroneous closed, latched, and locked indication should be no greater than $1x10^{-5}$ for:

- each door subject to pressurisation and for which the initial opening movement is not inward; and for
- each door that could be a hazard if unlatched.

(e)(4) There must be an aural warning to the pilots prior to or during the initial portion of take-off roll if any door is not fully closed, latched, and locked and its opening would prevent a safe take-off and return to landing.

Where an unlatched door could open and prevent a safe take-off and return to landing, a more conspicuous aural warning is needed. It is intended that this system should function in a manner similar to the take-off configuration warning systems of CS 25.703 [Take-off Warning system]. The visual display for these doors may be either a red light or a display on the master warning system. Examples of doors requiring these aural warnings are:

- doors for which the structural integrity of the fuselage would be compromised if the door is not fully closed, latched and locked, or
- doors that, if open, would prevent rotation or interfere with controllability to an unacceptable level.

CS 25.783(f) Visual inspection provision

Each door for which unlatching could be a hazard, must have provisions for direct visual inspection to determine, without ambiguity, if the door is fully closed, latched, and locked. The provision must be permanent and discernible under operational lighting conditions or by means of a flashlight or equivalent light source.

A provision is necessary for direct visual inspection of the closed position of the door and the status of each of the latches and locks, because dispatch of an aeroplane may be permitted in some circumstances when a flight deck or other remote indication of an unsafe door remains after all door closing, latching and locking operations have been completed. Because the visual indication is used in these circumstances to determine whether to permit flight with a remote indication of an unsafe door, the visual indication should have a higher level of integrity than, and be independent of, the remote indication.

(a) The provisions should:

1) allow direct viewing of the position of the locks to show, without ambiguity, whether or not each latch is latched and each lock is in the locked position. For doors which do not have a lock for each latch, direct viewing of the position of the latches and restraining mechanism may be necessary for determining that all the latches are latched. Indirect viewing, such as by optical devices or indicator flags, may be acceptable provided that there is no failure mode that could allow a false latched or locked indication.

2) preclude false indication of the status of the latches and locks as a result of changes in the viewing angle. The status should be obvious without the need for any deductive processes by the person making the assessment.

3) be of a robust design so that, following correct rigging, no unscheduled adjustment is required. Furthermore, the design should be resistant to unauthorised adjustment.

4) preclude mis-assembly that could result in a false latched and locked indication.

(b) If markings are used to assist the identification of the status of the latches and locks, such markings must include permanent physical features to ensure that the markings will remain accurately positioned.

(c) Although the visual means should be unambiguous in itself, placards and instructions may be necessary to interpret the status of the latches and locks.

(d) If optical devices or windows are used to view the latches and locks, it should be demonstrated that they provide a clear view and are not subject to fogging, obstruction from dislodged material or giving a false indication of the position of each latch and lock. Such optical devices and window materials should be resistant to scratching, crazing and any other damage from all materials and fluids commonly used in the operation and cleaning of aeroplanes.

CS 25.783(g) Certain maintenance doors, removable emergency exits, and access panels

Some doors not normally opened except for maintenance purposes or emergency evacuation and some access panels need not comply with certain sub-paragraphs of this paragraph as follows:

(1) Access panels that are not subject to cabin pressurisation and would not be a hazard if open during flight need not comply with sub-paragraphs (a) through (f) of this paragraph, but must have a means to prevent inadvertent opening during flight.

(2) Inward-opening removable emergency exits that are not normally removed, except for maintenance purposes or emergency evacuation, and flight deck-openable windows need not comply with sub-paragraphs (c) and (f) of this paragraph.

(3) Maintenance doors that meet the conditions of sub-paragraph (h) of this paragraph, and for which a placard is provided limiting use to maintenance access, need not comply with sub-paragraphs (c) and (f) of this paragraph.

Some doors not normally opened except for maintenance purposes or emergency evacuation and some access panels are not required to comply with certain sub-paragraphs of CS 25.783 as described in CS 25.783(g). This generally pertains to access panels outside pressurised compartments whose opening is of little or no consequence to safety and doors that are not used in normal operation and so are less subject to human errors or operational damage.

CS 25.783(h) Doors that are not a hazard

For the purpose of this paragraph, a door is considered not to be a hazard in the unlatched condition during flight, provided it can be shown to meet all of the conditions as mentioned in CS 25.783(h).

CS 25.783 recognises four categories of doors:

- Doors for which the initial opening is not inward, and are presumed to be hazardous if they become unlatched.
- Doors for which the initial opening is inward, and could be a hazard if they become unlatched.
- Doors for which the initial opening is inward, and would not be a hazard if they become unlatched.
- Small access panels outside pressurised compartments for which opening is of little or no consequence to safety.

CS 25.783(h) describes those attributes that are essential before a door in the normal (unfailed) condition can be considered not to be a hazard during flight.

6. STRUCTURAL REQUIREMENTS

In accordance with CS 25.571, the door structure, including its mechanical features (such as hinges, stops, and latches), that can be subjected to airframe loading conditions, must be designed to be damage tolerant. In assessing the extent of damage under CS 25.571 and CS

25.783 consideration should be given to single element failures in the primary door structure, such as frames, stringers, intercostals, latches, hinges, stops and stop supports.

The skin panels on doors should be designed to be damage tolerant with a high probability of detecting any crack before the crack causes door failure or cabin decompression.

III) ORIGINAL JAA NPA PROPOSALS JUSTIFICATION

Note: Where relevant references to JAA and JAR have been replaced by EASA and CS respectively.

PART I; PROPOSALS FOR DEFINITIONS

For the purpose of understanding the remainder of this proposal, the following definitions are proposed (ref. AMC 25.783).

A latch is a movable mechanical element that, when engaged, prevents the door from opening.

A lock is a mechanical element that monitors the latch position, and when engaged, prevents the latch from becoming disengaged.

Latched means the latches are engaged with their structural counterparts and held in position by the latch operating mechanism.

Locked means the locks are engaged.

Latching mechanism includes the latch operating mechanism and the latches.

Locking mechanism includes the lock operating mechanism and the locks.

Closed means that the door has been placed within the doorframe in such a position that the latches can be operated to the "latched" condition.

Fully closed means that the door is placed within the doorframe in the position it will occupy when the latches are in the latched condition.

PART II: PROPOSALS (1 THROUGH 11) TO THE REQUIREMENT PERTAINING TO THE PARTICULAR SUBJECT OF FUSELAGE DOORS (CS 25.783)

PROPOSAL 1

The EASA proposes to change the title of the revised CS 25.783 to "Fuselage doors" in order to more accurately reflect the applicability of this revised paragraph.

Discussion

The term "doors" as used in the proposed CS 25.783 would also include, hatches, openable windows, access panels, covers, etc., on the exterior of the fuselage that do not require the use of tools to open or close. This would also include each door or hatch through a pressure bulkhead, including any bulkhead that is specifically designed to function as a secondary pressure bulkhead under the prescribed failure conditions of CS 25.

PROPOSAL 2

The EASA proposes to delete the present CS 25.783(a). This rule is considered to be obsolete for CS-25 and need not be relocated to CS 25.807. The new CS 25.783(a) has been added to describe the type of doors for which CS 25.783 is applicable.

Discussion

The formatting and portions of the text of proposed CS 25.783(a) would be totally revised. The EASA proposes that the new CS 25.783(a) would describe the types of doors for which this paragraph of the regulation is applicable and would clarify the fact that the requirements are intended to apply to the unpressurised portions of flight as well as to pressurised flight. Proposed CS 25.783(a) would also provide the general design requirements for doors.

These general design requirements are not substantively different from the requirements contained in the existing CS 25.783. A reference to the locking requirements contained in CS 25.607 ("Fasteners") would be included in sub-paragraph CS 25.783(a) since experience has shown that it is advisable to add this reference to ensure it is not overlooked.

PROPOSAL 3

The EASA proposes to amend the current CS 25.783(b) and relocate the current text related to the opening of the door to CS 25.809.

Discussion

Sub-paragraph CS 25.783(b) would be revised to require safeguards against both inadvertent and intentional opening of doors during flight. It would clarify the existing requirement that doors must be prevented from opening inadvertently (that is, not deliberately, and without forethought, consideration, or consultation) by persons on board the aeroplane during flight. The intent of this requirement is to protect both the passenger and the aeroplane from hazards resulting from the unintentional actions by persons on board.

In addition, the proposal would make it clear that the door must be safeguarded against intentional opening during flight by persons on board. The proposed text requires that the possibility of intentional opening by persons be minimised .The intent of this requirement is that, for doors in pressurised compartments, it should not be possible to open the doors after take-off, when the compartment is pressured to a significant level. (During approach, take-off, and landing when compartment differential pressure is lower, it is recognised that intentional opening may be possible; however, during these short phases of the flight, all passengers are expected to be seated with seat belts fastened. The exposure to intentional opening would therefore be minimised). Further guidance on this subject is given in CS-25 Book 2 AMC.

Further, for doors that can be opened under significant cabin pressure, or for doors in non-pressurised aeroplanes, the use of an auxiliary securing means, such as speed- or barometrically-activated devices, may be necessary. Past interpretations of the existing CS 25.783(f) have resulted in this type of design requirement being applied to type certification projects. In addition, the proposed CS 25.783(b) would require that, if auxiliary devices are used, they be designed so that no single failure or malfunction could prevent more than one exit from opening.

PROPOSAL 4

The EASA proposes to delete the current CS 25.783(c), since its text is duplicated in the existing CS 25.809(g).

The EASA proposes that the new CS 25.783(c) would restate the existing requirement CS 25.783(f) for a provision to prevent the aeroplane from becoming pressurised if the door is not fully closed, latched and locked.

Discussion
The current requirement states:
"External doors must have provisions to prevent the initiation of pressurisation of the aeroplane to an unsafe level if the door is not fully closed and locked. . . "
However, this proposal would remove the phrase, ". . . the initiation of . . ." from this text because it is inconsistent and confusing with regard to a common method of preventing pressurisation that employs vent doors. Mechanical vent doors allow the pressurisation system to initiate and a small amount of pressure may exist as the air flows through the vents. The revised text would correct this inconsistency. It also would allow for certain types of doors that can safely and reliably act as their own venting mechanism when not fully closed and latched, or that would automatically close and latch, as appropriate to the door design, before an unsafe level of pressure is reached. For these doors without an independent means, the assessment for a safe and reliable closing would include consideration of single failures and adverse conditions, such as debris in the doorway.

Proposed CS 25.783(c) also would provide a definitive criterion for the reliability level of the pressurisation prevention system that is consistent with the interpretation of the general text of the existing rule, and that also is consistent with current industry practice for new designs. This proposed criterion is not intended to impose a new level of reliability for mechanical vent systems that is more stringent than that established by typical fail-safe designs. However, it would provide a definitive criterion for use in evaluating these vent systems or other systems that may interconnect with the aeroplane's pressurisation system. A pressurisation prevention means that would function with a high degree of reliability in spite of operator and flight crew errors, would be consistent with NTSB Safety Recommendation A-89-094, described previously, which recommends fail-safe features that account for conceivable human errors.

PROPOSAL 5
The EASA proposes to delete the current CS 25.783(d) and relocate it to a new CS 25.809(f). Proposed CS 25.783(d) would provide requirements for the detail design and fail-safe features of latching and locking mechanisms.

Discussion
The EASA proposes that the new sub-paragraph CS 25.783(d) would provide requirements for the detail design and fail-safe features of latching and locking mechanisms. Some of these design features are currently recommended in the existing FAA Advisory Circular (AC) 25.783-1 "Fuselage Doors, Hatches, and Exits," dated December 10, 1986 and the JAA Guidance Material in NPA 25D-218 dated June 1996; the proposed rule would make these features mandatory. One provision of this proposed requirement, which would require the removal of all power that could initiate the unlatching and unlocking of the door during flight, is based on NTSB Safety Recommendation A-92-21, discussed previously.

For the most part, the detail design requirements for latches and locks contained in this proposed sub-paragraph are consistent with current industry practice, as applied to doors whose initial movement is not inward. However, the applicability of the proposed requirement would be extended to any door, unless it can be shown that unlatching would not be a hazard.

Proposed CS 25.783(d) also would require that the latching mechanism be designed to eliminate forces that would tend to drive the latches to the open position. However, it is recognised that there may still be ratcheting forces that could progressively move the latches to the unlatched position. Therefore, the rule also would require that the latching system be designed such that the latches are positively secured without regard to the position of the locks.

A new provision in this proposed sub-paragraph is the requirement for a fail-safe criterion for the locking system that would apply only to outward opening doors while under pressure. Since all the locks are usually designed as a single locking system, it is possible that single failures in the locking system could result in the unlocking of several or all the latches. Although the latches would continue to be held in the latched position by the latch system securing means, the EASA (and FAA) have determined that, for these more critical designs, during pressurised flight, single failures in the locking system should not cause the number of latches remaining locked to be less than that needed to restrain the door.

PROPOSAL 6

The EASA proposes to revise CS 25.783(e) by relocating the current part of CS 25.783(e), related to the provision for direct visual inspection of the locking mechanism, to the new CS 25.783(f) and by providing additional features to the new CS 25.783(e).

Discussion

The EASA proposes that the revised CS 25.783(e) would provide the requirements for warning, caution, and advisory indications for doors. These requirements for indication are similar to the current provisions for indication of door status in this paragraph, but provide additional features consistent with NTSB and ATA recommendations. The prescribed "improbable" level for an erroneous indication that the door is fully closed, latched, and locked is proposed to be the same as the requirement of the existing CS 25.783(e), except that the applicability would be extended to each door, if unlatching of the door in flight could be a hazard.

Proposed CS 25.783(e) also would require an aural warning before take-off for each door, if opening of the door would not allow safe flight. The EASA/FAA have determined that this requirement is necessary, based on service history. It is intended that this system should function in a manner similar to the take-off configuration warning systems required by CS 25.703 ("Take-off warning system").

Proposed CS 25.783(e) also would require that there be a positive means to display indications and signals to the door operator. This proposed requirement is consistent with NTSB Safety Recommendation A-89-093, discussed previously.

PROPOSAL 7

The EASA proposes that the current CS 25.783(f) is relocated to the new CS 25.783(c) and that the current part of CS 25.783(e), related to the provision for direct visual inspection of the locking mechanism, will become the new CS 25.783(f).

Discussion
The EASA proposes that the new CS 25.783(f) would provide the requirement for direct visual inspections to determine that the door is fully closed, latched and locked. This requirement is similar to the existing rule for visual inspection provisions. It would be extended to cover doors irrespective of the initial movement if the unlatched door could be a hazard.

PROPOSAL 8
The EASA proposes to delete the current CS 25.783(g) since all types of cargo and service doors must meet the new CS 25.783 rule. The new CS 25.783(g) has been added.

Discussion
The EASA proposes that the new CS 25.783(g) would provide relief from certain requirements of the current rule that are applicable to access panels not subject to pressurisation and for which unlatching would not have a detrimental effect on safety. In addition, the proposal would provide relief from certain of the current requirements applicable to:

- maintenance doors that are not a hazard if unlatched; and
- removable emergency exits, because they are not used in normal operation and therefore not subjected to the same level of human error, abuse, and damage as other doors and hatches.

PROPOSAL 9
The EASA proposes to delete the current text of CS 25.783(h) and relocate this text to a new CS 25.807(k) and to keep in the proposed CS 25.783(a)(6)a reference to the new CS 25.807(h)) for exits other than emergency exits.
The proposed new CS 25.783(h) would prescribe detail design features that a door would need to have if it were to be considered as a door that is "not a hazard" when this phrase is used in other sub-paragraphs of CS 25.783.

Discussion
Several of the proposed safety standards are applicable to doors that would be a hazard if they opened or became unlatched in flight. The EASA proposes that the new sub-paragraph CS 25.783(h) prescribes detail design features that a door would need to fulfil if it were to be considered as a door that would not be a hazard.

PROPOSAL 10
The EASA proposes that the current requirements of CS 25.783(i) that apply to the design of air stairs (integral stair installed in a passenger entry door that is qualified as a passenger emergency exit) would be removed from CS 25.783 and placed in CS 25.810 ("Emergency egress assist means and escape routes") as sub-paragraph CS 25.810(e), without change in text.

Discussion
The EASA considers that the seeking of compliance with rules would be better served by having these requirements located in the same paragraph of the rules where other related requirements are found.

PROPOSAL 11

The EASA proposes that the special requirement for lavatory doors contained in the existing CS 25.783(j) would be removed and set forth without change in a new CS 25.820 "Lavatory doors".

Discussion

The EASA considers that less confusion will be caused, and the regulated public will be better served, if all requirements pertaining to this particular subject are located in one separate place.

PART III:
PROPOSALS (12 THROUGH 19) TO REQUIREMENTS PERTAINING TO THE PARTICULAR SUBJECT OF EMERGENCY EXITS (CS 25.807,-809,-810.-820)

Several other provisions currently in CS 25.783 would be deleted, since they duplicate the requirements applicable to emergency exit design, or would be moved without substantive change to other paragraphs of CS-25 (Ref. PROPOSALS 2,3,4,5,9,10 and 11). The EASA considers that less confusion would be caused, and that the regulated public would be better served, if all requirements pertaining to a particular subject are located in one place. In this regard, the EASA is proposing specific changes. Furthermore, several requirements in CS 25.809(f) that duplicate the door design requirements in CS 25.783 would be deleted.
The arrangements of the paragraphs in the following proposals take into consideration the changes proposed in NPA 25D-298, issue 2 (12 July 1999) *Type and Number of Passenger Emergency Exits*. NPA 25D-298 adopts Amendment 88 and 94 to FAR Part 25.

PROPOSAL 12

The EASA proposes to revise the text of CS 25.807(h) as it has been proposed by NPA 25D-298. NPA 25D-298 adopts FAR Part 25 Amendment 25-88. As a result of the harmonisation process it revealed that an inadvertent omission was present in Amendment 25-88. The text of this proposal is already existing in JAR 25.807(d)(6) Change 14, but was inadvertently deleted by the adoption of FAR Amendment 25-88 through NPA 25D-298. This omission has been rectified with this proposal.

Discussion

The existing CS 25.783 requires that passenger entry doors also meet the airworthiness standards required for emergency exits. In addition, the current CS 25.807(d)(6), requires that certain other fuselage doors, in addition to passenger entry doors, meet the same standards as emergency exits. Prior to the adoption of Amendment 25-88 (61 FR 57956, November 8, 1996), 14 CFR part 25 also contained a requirement similar to that of JAR 25.807; however, that requirement was inadvertently omitted in the adoption of Amendment 25-88.
This proposed rule would correct this discrepancy by setting forth this requirement in a revised CS 25.807(h), and by proposing CS 25.783(a)(6) to refer to that sub-paragraph.
Specifically, the proposed CS 25.807(h) would be revised to refer to "other exits" that must meet the applicable emergency exit requirements of CS 25.809 through CS 25.812. The reference to CS 25.813 has been deleted. The reason to limit the requirements is that CS 25.813 is the accessibility requirement, and to require the same accessibility for an exit that is above and beyond the minimum, basically provides a disincentive to have such exits. Those

“other exits” include:

Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits;

Floor-level doors or exits that are accessible from the passenger compartment and larger than a Type II exit, but less than 1.17m (46 inches) wide; and

Ventral or tail cone passenger exits.

PROPOSAL 13

The EASA proposes to revise CS 25.807 and to relocate the current text of CS 25.783(h) to a new CS 25.807(k).

Discussion

See PROPOSAL 9.

PROPOSAL 14

The EASA proposes to revise CS 25.809(b) by adding the text of the current CS 25.783(b) related to inward opening doors to CS 25.809(b).

Discussion

This specific requirement is currently a part of CS 25.783(b), but is more appropriate as part of the emergency exit arrangement requirements of CS 25.809.

PROPOSAL 15

The EASA proposes to revise CS 25.809(b) by adding a new CS 25.809(b)(3) to require that each emergency exit must be capable of being opened, when there is no fuselage deformation, “even though persons may be crowded against the door on the inside of the aeroplane.”

Discussion

This specific requirement is currently a part of CS 25.783(b), but is more appropriate as part of the emergency exit arrangement requirements of CS 25.809.

PROPOSAL 16

The EASA proposes to revise CS 25.809(c) to include the requirement that the means of opening emergency exits also must be marked so that it can be readily located and operated, even in darkness.

Discussion

This specific requirement is currently a part of CS 25.783(b), but is more appropriate as part of the emergency exit arrangement requirements of CS 25.809.

PROPOSAL 17

The EASA proposes to delete the current CS 25.809(f) since this specific requirement is now covered in the new CS 25.783.

The EASA proposes to add a new CS 25.809(f) to require that the external door be located where persons using it will not be endangered by the propellers when appropriate operating procedures are used

Discussion
This specific requirement is currently a part of CS 25.783(d), but is more appropriate as part of the emergency exit arrangement requirements of CS 25.809.

PROPOSAL 18

The EASA proposes to allocate a new CS 25.810(e) for the relocation of the current text of CS 25.783(i).

Discussion
See PROPOSAL 10.

PROPOSAL 19

The EASA proposes to allocate a new CS 25.820 for the relocation of the current text of CS 25.783(j).

Discussion
See PROPOSAL 11.

ECONOMIC IMPACT EVALUATION/ASSESSMENT

The JAA has concluded that the provisions of this proposal would impose relatively small costs and, in some cases, result in minor cost savings. Accordingly, the JAA has not made specific cost estimates, but have only provided qualitative cost indications for each proposed change, as follows:

PROPOSAL 1/2: Sub-paragraph CS 25.783(a) is descriptive and has no expected cost.
PROPOSAL 3: Sub-paragraph CS 25.783(b) relates to opening by persons. The requirement to consider intentional opening is new, but is expected to be accommodated, for the most part, in existing design practices. (Requirements regarding inadvertent opening are not new.)
PROPOSAL 4: Sub-paragraph CS 25.783(c) covers means to prevent pressurisation. The requirement to consider single failures in the pressurisation-inhibit system is new, but is believed to be already complied with in virtually all cases. Thus, there is likely to be very little, if any, cost for a new design. The provision to permit certain doors to forego this system is actually cost-relieving, and could result in a minor cost reduction in some cases.
PROPOSAL 5: Sub-paragraph CS 25.783(d) covers latching and locking. Most of these changes are the incorporation of recommendations currently contained in an advisory circular. The vast majority of aeroplanes already comply, and basic design practice is to comply with these requirements. Therefore, these requirements, while new, should have minimal cost impact. The requirement to eliminate forces in the latching mechanism that could load the locks is new, and may not be complied with in all cases currently, but is not expected to add costs. The requirement for each latch to have a lock, which must monitor the latch position, is a formalisation of existing practice. Therefore, while a new rule, it should not impose a substantive cost.
PROPOSAL 6: Sub-paragraph CS 25.783(e) covers warning, caution, and advisory

indications. The reliability of the door indication system will be required to be higher for all doors. This would have only a small cost impact, as would the requirement for an aural warning for certain doors, and the requirement to provide an indication to the door operator.
PROPOSAL 7: Sub-paragraph CS 25.783(f) contains the visual inspection provision requirement. The requirement for direct visual inspection is extended to more door types, and may add minor costs in some cases.
PROPOSAL 8: Sub-paragraph CS 25.783(g) deals with certain maintenance doors, removable emergency exits, and access panels. The current rule does not provide the relief that the proposed rule does, although the AC has indicated that relief is possible. This provision could reduce costs in some cases.
PROPOSAL 9: Sub-paragraph CS 25.783(h) covers doors that are not a hazard and is intended to provide relief for certain doors, so it could reduce costs.
PROPOSAL 10 through 19: Sub-paragraphs CS 25.783(i), CS 25.783(j), CS 25.809(b), CS 25.809(c), and CS 25.809(f) move text to another paragraph and has no economic impact.
PROPOSAL 12: Paragraph CS 25.807 simply corrects an unintended deletion.

Summary of Benefit and Cost Considerations.

The proposed rule is expected to:

- maintain or provide a slight increase in the level of safety, when compared to current industry practice.
- have only a relatively small effect on costs when compared to current industry practice, and
- provide some cost savings to manufacturers by avoiding duplicative testing and reporting that could result from the existence of differing requirements under the current standards.

The EASA concurs with the JAA Cost/Benefit assessment and considers that the proposed rule would be cost-beneficial. This is reinforced by industry's support for the proposal.

IV) JAA NPA COMMENT-RESPONSE DOCUMENT

COMMENT/RESPONSE DOCUMENT on NPA 25D-301 ISSUE Sept.2001 FUSELAGE DOORS

Note that standard EASA transition arrangements have been applied in transforming the JAA NPA into a form acceptable to EASA, and that this may overrule responses given in this Comment Response Document. (e.g. the use of SI units is mandatory throughout the EASA codes.

No.	From (Organisation)	Affected paragraph	Comment	Response
1	DGAC-France			*Noted*
2	CAA -UK	ACJ §7	Paragraph 7, Structural Requirements As with all new JARs, the proposed changes to JAR-25 Requirements and ACJ material contained in this NPA will only be applicable to future designs and major modifications that, by virtue of their application date, attract the latest certification standards. In that case, there is no need to discuss, at all, the fail-safe requirements that belong to a much earlier certification standard. The reference to FAR 25 Amendment 45 has no relevance to this JAR-25 ACJ and should be avoided. To achieve this, it is proposed to simplify the text of this paragraph as follows: "In accordance with §25.571, the door structure, including its mechanical features (such as hinges, stops, and latches), that can be subjected to airframe loading conditions, must be designed to be damage tolerant. In assessing the extent of damage under §25.571 and §25.783 consideration should be given to single element failures in the primary door structure, such as frames, stringers, intercostals, latches, hinges, stops and stop supports. The skin panels on doors should be designed to be damage tolerant with a high probability of detecting any crack before the crack causes door failure or cabin decompression."	*Proposal accepted with amendment:* *This paragraph included the older fail-safe requirements as a left over from the FAA AC. An example of this standard is still the door stop. The text as proposed however has been accepted, except that the word "must" has been changed into "should".* EASA comment: – "must" is retained in line with adopted protocol. (See AMC 25.783 Paragraph 1)
3	CAA UK	§25.783(h)(1)	JAR 25.783(h)(1) This paragraph uses the Imperial pressure measure of ½ psi to express a limitation. To be	*Proposal accepted:*

No.	From (Organisation)	Affected paragraph	Comment	Response
			consistent with European Union legislation the appropriate S.I. value should also be included.	*Amended § to read 0,035 kg/cm² (0,5 PSI).*
4	CAA-UK	§25.807(h)(2)	JAR 25.807(h)(2) This paragraph uses the Imperial dimension of 46 inches to express a limitation. To be consistent with European Union legislation the appropriate S.I. value should also be included.	*Proposal not accepted:* *The NPA only transferred this unchanged text to §25.807(h)(2) to give it a better place.* *Correction of this Inconsistency to be initiated by the Cabin Safety Group*
5	CAA-UK	§25.809(b)	JAR 25.809(b) The text "……….to an extend that would interfere……." should read "……………….to an extent that would interfere………"	*Proposal accepted:* *Corrected typo in §25.809(b).*
6	CAA-UK	ACJ25.783	ACJ 25.783 In various places this ACJ uses the Imperial measures ½ psi, 2 psi and 300 pounds to express limitations. To be consistent with European Union legislation the appropriate S.I. value should also be included.	*Proposal accepted:* *Amended ACJ to read 0,035 kg/cm² (0,5 PSI, 0,14 kg/cm²(2 psi) and 136 kg (300 lb)*
7	Embraer	ACJ	The proposed NPA is supported by ACJ. Until the content of the NPA is not harmonised, it should be defined if the new paragraphs are classified as SRD.	*Noted*
8	Embraer	ACJ§4	DEFINITIONS OF TERMS: As it has a considerable impact on the design of the locking system, it is very important to classify precisely if the door is inward-opening plug door or not. An objective criteria should be established to emphasis the INWARD term defining a rate of directional component of movement that must be inward with respect to the mean pressure plane in order to classify a initial movement as inward.	*Noted and further documented in item 17.*
9	CAA-NL	§25.783(a)(5)	<u>Background.</u> CAA-NL took the action (ACTION 90/14-10) to	*Comment understood but*

No.	From (Organisation)	Affected paragraph	Comment	Response
			provide the D&FSG comment on this paragraph to the JAA. The comment was that it should be clarified in the ACJ that §25.607 should only be applied when hazardous consequences result. Proposal. Add to the ACJ text the following*: Fuselage doors that are not a hazard (ref. §25.783(h)) do not need to comply with the locking requirements of §25.607.*	*proposal not retained. § 25.607 is a general requirement for the aeroplane and not be excluded for §25.783. The relief as proposed by the commenter is already provided in §25.607 itself.*
10	CAA-NL	§25.783(b)	Background. Recently, incidents (6 on F100 and one on Dornier 328) have been reported on passenger doors (both outward opening and semi-plug type doors) were the passenger door opened during the take-off phase of the flight. The cause of the incident in these 7 cases was not a failure in the door locking mechanism, but the door was opened by the cabin crew for reasons that were not always clarified. In all the cases the opened door stayed attached to the aeroplane and the flight ended safely. In the Dornier DO328 case both the structural door hinges were severely cracked, but the door stayed attached. It is the opinion of CAA-NL that, despite the requirement that design precautions must be taken to minimise the possibility for a person to open a door during flight, it should be demonstrated for doors that could be a hazard, that the door hinge design is strong enough for the case of door opening during the take-off phase. Proposal. CAA-NL proposes to add to 25.783(b) the requirement that in the case the door opens during take-off phase for any reason, that it must be shown that the door remain attached to the fuselage at the applicable speeds and that a safe turnaround and landing can be made with the door open. This needs to be further explained in the ACJ.	*Comment understood but proposal not retained completely: The reason is that the Failure Condition as described by the commenter has already been foreseen in the Proposal 6. §25.783(e)(2) provides a positive means to display indications and signals to the door operator. This will prevent opening of the doors in flight by cabin attendants and the demonstration for the strength of door hinges in the case of door opening during take-off is therefore not required. In ACJ §25.783(b)*

No.	From (Organis ation)	Affected paragraph	Comment	Response
				section (a) text has been added to consider the case of door opening during take-off by a cabin crew member.
11	CAA-NL	§25.783(e)(1) and (e)(2)	<u>Background.</u> After occurrences of pax door opening in flight on a certain product, CAA-NL has made this paragraph applicable to an outward opening door design. The reason was to prevent the cases of passenger door opening during take-off, where the cabin crew, for their own reasons, moved the door handle, which resulted in door opening in flight. An AD was published where a door indicator light at the cabin crew station was introduced. During certification of that modification it was discovered that NPA25D-301 did not provide reliability requirements for that indication light. Discussion resulted in the statement that this cabin crew indicator light should be not less reliable as the cockpit indication and further that it is highly undesirable that cabin crew and cockpit might get different indications. Therefore it was decided to use the same switches (sensors) for both the cabin- and cockpit indication. <u>Proposal.</u> The following sentence should be added to the ACJ 25.783(e)(2): *In case of an indicator light, it should not be less reliable than the visual means in the cockpit as required per 25.783(e)(3). Preferably the same sensors should be used for both indications in order to prevent discrepancies between the indications.*	*Proposal accepted and retained with amendment as follows: ..any discrepancy… i.s.o. …discrepancies …*
12	CAA-UK	Proposal 3	Page 4, PROPOSAL 3, Discussion paragraph 3. existing text: . "In addition, the proposed § 25.783(b) would require that, if auxiliary devices are used, they be designed so that no single failure or malfunction could prevent more than one exit from opening." Auxiliary devices generally require complex	*Comment understood and proposal retained as amended as follows: §25.783(b) unchanged. ACJ25.783(b) added text to*

No.	From (Organisation)	Affected paragraph	Comment	Response
			operating systems to ensure that correct operation is maintained under normal and abnormal operational regimes, with the result that dormant failures in combination with other dormant or evident failures could prevent more than one door from opening. To ensure such designs are prohibited it is suggested that the subject paragraph be amended to read: *"In addition, the proposed § 25.783(b) would require that, if auxiliary devices are used, they be designed so that no single failure or malfunction and no dormant failure or malfunction in combination with other dormant or evident failures or malfunctions could prevent more than one exit from opening.*	*address dormant failures.* *(See "EASA Note" below)*
13	CAA-UK	Proposal 5	Page 4, PROPOSAL 5, Discussion paragraph 5, existing text: "Although the latches would continue to be held in the latched position by the latch system securing means, the JAA (and FAA) have determined that, for these more critical designs, during pressurised flight, single failures in the locking system should not cause the number of latches remaining latched to be less than that needed to restrain the door." It is considered that a typographical error in the last line has erroneously inserted the word 'latched' instead of 'locked'. The subject refers to the integrity of the locking system and the need to ensure that single failures in the locking system do not result in an excessive number of latches becoming unlocked. It is obvious that sufficient latches to restrain the door must remain latched. "Although the latches would continue to be held in the latched position by the latch system securing means, the JAA (and FAA) have determined that, for these more critical designs, during pressurised flight, single failures in the locking system should not cause the number of latches remaining locked to be less than that needed to restrain the door."	*Proposal accepted.*
14	CAA-UK	§25.783(b)	Similarly, page 8, § 25.783 Fuselage doors (b) Opening by persons, (i) existing text:	*Proposal understood but*

No.	From (Organisation)	Affected paragraph	Comment	Response
			"no single failure will prevent more than one exit from being opened, and" Amend to read: *No single failure or malfunction and no dormant failure or malfunction in combination with other dormant or evident failures or malfunctions will prevent more than one exit from being opened, and"*	*not accepted. For reason see comment 12.* *(Also See "EASA Note" below)*
15	CAA-UK	§25.783(d)(3)(iii)	"be designed so that, during pressurised flight, no single failure in the locking system would prevent the locks from restraining the latches as necessary to secure the door." Amend to read: *"be designed so that, during pressurised flight, no single failure in the locking system would prevent the locks from restraining the latches ~~as~~ necessary to secure the door."*	*Proposal understood and accepted.*
16	CAA-UK	§25.783(e)(2)	"There must be a positive means clearly visible from the operator station for each door to indicate if the door is not fully closed, latched, and locked for each door that could be a hazard if unlatched." Suggest amend the text to eliminate the repetitive reference to 'each door' *"There must be a positive means clearly visible from the operator station for each door that could be a hazard if unlatched, to indicate if the door is not fully closed, latched, and locked ~~for each door that could be a hazard if unlatched."~~*	*Proposal understood and accepted.*
17	CAA-UK	ACJ§4	A definition of *"initial inward opening movement"* to follow *"inward"* is required. Trial application of this PNPA has resulted in design proposals that claim to meet the definition of a door having 'initial inward opening' movement and, whilst theoretically this was true, in practice, the degree of inward movement and the range over which it was effective was so small that the safety advantages of this design feature would not	*Proposal understood and accepted as an improvement in clarity over the current ACJ text.*

No.	From (Organisation)	Affected paragraph	Comment	Response
			be obtained. The alleviation from some design features that is permitted for doors with initial inward opening movement is predicated on the principle that pressurisation loads tend to move the door to the closed position. As such, the mechanism that provides the inward movement must be sufficiently robust to withstand the pressurisation loads of at least 2 psi. [see 25.783(d)(2)] without assistance from the fixed stops that normally restrain the door in the closed position, and the door closing component of the pressurisation loads should be effective over a range such that the loss of cabin air past the partially open door is sufficient to prevent pressurisation greater than 0.5 psi.[see § 25.783(a)(1)(a), page 15] Suggested text: *"initial inward opening movement". In order for a door design to be classified as having an inward initial opening movement, the provisions provided to guide the door inward must have:* *1, sufficient rigidity and strength to fulfil their function with a pressure of at least 2 psi applied to the door.* *2, sufficient range to maintain the closing component from the pressurisation load until the loss of cabin air past the partially open door is such that cabin pressurisation greater than 0.5 psi cannot be maintained.* *3, design features that ensure that adjustment / wear of the door stops, guides, rollers or associated mechanism cannot negate the means provided to move the door inwards.* If this revision is adopted the limite classification of a door with an inward initi opening movement contained in §25.783(d)(2 page 16 can be deleted. ~~In order for a design to be classified as having an inward initial opening movement, it should be shown that the provisions provided to guide the door inward have sufficient rigidity and strength to fulfill their function with a pressure of at least 2 psi applied to the door.~~	
18	CAA-UK	ACJ§4	*"Locked"* means the locks are engaged	*Proposal*

No.	From (Organisation)	Affected paragraph	Comment	Response
			As the engagement of the locks may occur prior to the locks being secured in the locked position it is suggested that, as for the definition of "latched", the text is amended to include 'and held in position by the lock operating mechanism'. *"Locked"* means the locks are engaged and held in position by the lock operating mechanism	*understood and accepted to provide more clarity in the ACJ text.*
19	CAA-UK	ACJ §25.783(d)(2)(e)	Existing text: The latch securing means must be independent of the locking means. However, the latching and locking functions may be fulfilled by a single operating means, provided that it is not possible to back-drive the locks via the latch mechanism when the door is locked. Clearly it must not be possible for the lock system to be back-driven by loads on the latches when the door is locked, but additionally the lock system must be sufficiently independent from the latch system that back-driving is not possible at least while the locks are engaged with the latching system. The latch securing means must be independent of the locking means. However, the latching and locking functions may be fulfilled by a single operating means, provided that it is not possible to back-drive the locks via the latch mechanism when the ~~door is locked~~ locks are engaged with the latch mechanism.	*EASA Accepted*
20	CAA-UK	ACJ §25.783(d)(7)(iii)	Existing text: "Although the locks are not the primary means of keeping the latches engaged, they must have sufficient strength to withstand any loads likely to be imposed during all approved modes of door operation. The operating handle loads on manually operated doors should be based on a rational human factors evaluation. However, handle forces in excess of 300 pounds need not be considered." Trial application of this PNPA has resulted in	*Proposal understood and accepted to provide more clarity in the ACJ.*

No.	From (Organisation)	Affected paragraph	Comment	Response
			queries regarding the interpretation of the last sentence of this advisory text. It is suggested that the following minor amendment would clarify the intent. "Although the locks are not the primary means of keeping the latches engaged, they must have sufficient strength to withstand any loads likely to be imposed during all approved modes of door operation. The operating handle loads on manually operated doors should be based on a rational human factors evaluation. However, the application of forces on the handle ~~forces~~ in excess of 300 pounds need not be considered."	
21	CAA-UK	ACJ§ 25.783(e)(3)	Existing text: "The probability of erroneous closed, latched, and locked indication should be no greater than 0.00001 for" It is suggested that the more common form of probability is used for consistency with JAR 25.1309 analysis. "The probability of erroneous closed, latched, and locked indication should be no greater than $1x10^{-5}$ ~~0.00001~~ for"	*EASA Accepted*
22	CAA-UK	§25.783(d)	Many existing door designs incorporate features that prevent the latches from moving to the latched position if the door is not closed. This is an important feature that prevents the latched and locked functions being completed and correctly indicated even though the door is open, the only safeguard against dispatch being possibly one switch input to the indication system. It is a basic design philosophy for door security that each function should have independent integrity without reliance on the indication system to make good a shortfall in the design integrity of such functions. It is therefore proposed that a new requirement be introduced as follows: (3) Each door for which not being closed	*Proposal understood and accepted. The requirement has been renumbered to (d)(8) i.s.o. (d)(3). In addition to the commenter proposal ACJ material has been added to provide guidance material to the new requirement.*

No.	From (Organisation)	Affected paragraph	Comment	Response
			could result in a hazard must have means to prevent the latches from being moved to the latched position unless the door is closed. Existing requirements (d)(3 –7) would be renumbered (d)(4 – 8)	

EASA Note

The safety intent is to ensure that, for each flight, no single failure within the auxiliary device or its controlling mechanism will effect more than one door, irrespective of its probability of occurrence. The design of the auxiliary device and its controlling mechanism should therefore preclude all common mode failures which could effect more than one door. Furthermore, it is necessary to identify the dormant functions that in combination with other dormant or evident functions could prevent the door(s) from opening. This is particularly important if auxiliary devices are controlled by a central or complex system. In such assessments only the evident functions should be taken into account in showing compliance with the single failure criteria as, by definition, the status of the dormant functions is unknown and thus cannot be relied upon to be functional in the event of failure of the evident function during each flight.

C. JAA NPA 25DF-316 Cat.1 Items – Mechanical Systems (final Version dated September 2003)

I) <u>Explanatory Note</u>

(See also “A.I: General Explanatory Note”)

For practical reasons, the initial issue of CS-25 was based upon JAR-25 at Amendment 16. During the transposition of airworthiness JARs into certification specifications, however, the rulemaking activities under the JAA system where not stopped and significant rulemaking proposals have since been developed. In order to assure a smooth transition from JAA to EASA, the Agency has committed itself to continue as much as possible of the JAA rulemaking activities. It has therefore included most of the JAA rulemaking programme into its own plans. This EASA NPA is a result of this commitment and this section is based on JAA NPA 25D-316 which was circulated for comments from 1 June 2002 till 1 September 2002 and was agreed for adoption by the Regulation Sectorial Team on 11 September 2003.

JAA NPA 25D-316 was one NPA which implemented the JAA/FAA "Better Plan for Harmonisation". In this approach to harmonisation, agreed at the FAA/JAA annual meeting in June 1999, specific requirements were identified as "Category 1", where the intention was to define the harmonised standard to reflect the more severe position of the JAR-25 and FAR Part 25 requirements. The rationale for this approach was based on the knowledge that industry was already designing to the more severe standard to ease certification to both JAR-25 and FAR 25. The overall cost of certification should therefore be reduced without compromising safety. The harmonisation process for "Category 1" also required that the advisory material associated with the more severe standard is adopted for both codes.

II) PROPOSALS

The text of the amendment is arranged to show deleted text, new text or a new paragraph as shown below:

1. ~~Text to be deleted is shown with a line through it.~~
2. New text to be inserted is highlighted with grey shading.
3. New paragraph or parts are not highlighted with grey shading, but are accompanied by the following box text:

Insert new paragraph / part *(Include N° and title)*, or replace existing paragraph/ part

4. ….
   Indicates that remaining text is unchanged in front of or following the reflected amendment.
   ….

Book 1
SUBPART D DESIGN AND CONSTRUCTION

1. **Add reference to AMC in CS 25.729 to read:**

CS 25.729 Retracting mechanism

(See AMC 25.729)

….

2. **Add reference to AMC in CS 25.773 and amend CS 25.773(b) to read :**

CS 25.773 Pilot compartment view

(See AMC 25.773)

….

(b) *Precipitation conditions*. For precipitation conditions, the following apply:

(1) The aeroplane must have a means to maintain a clear portion of the windshield during precipitation conditions, sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of aeroplane. This means must be designed to function, without continuous attention on the part of the crew, in:

(i) Heavy rain at speeds up to 1.5 V_{SR1}, with lift and drag devices retracted; and

(ii) The icing conditions specified in CS 25.1419 if certification with ice protection provisions is requested. ~~(See AMC 25.773(b)(1)(ii))~~

(2) No single failure of the systems used to provide the view required by sub-paragraph (b)(1) of this paragraph must cause the loss of that view by both pilots in the specified precipitation conditions.

(3) The first pilot must have a window that is:

(i) ~~a window that is~~ Openable under the conditions prescribed in sub-paragraph (b)(1) of this paragraph when the cabin is not pressurised, ~~provides the view specified in that paragraph, and gives sufficient protection from the elements against impairment of the pilot's vision, or~~

(ii) Provides the view specified in that paragraph, and

(iii) Gives sufficient protection from the elements against impairment of the pilot's vision.

~~a. An alternative means to maintain a clear view under the conditions specified in sub-paragraph (b)(1) of this paragraph, considering the probable damage due to severe hail encounter.~~

(4) The openable window specified in sub-paragraph (b)(3) of this paragraph need not be provided if it is shown that an area of the transparent surface will remain clear sufficient for at least one pilot to land the aeroplane safely in the event of:

(i) Any system failure or combination of failures, which is not Extremely Improbable in accordance with CS 25.1309, under the precipitation conditions specified in sub-paragraph (b)(1) of this paragraph.

(ii) An encounter with severe hail, birds or insects.

….

3. Revise CS 25.851(b)(2) to read:

CS 25.851 Fire extinguishers

….

(b) Built-in fire extinguishers. If a built-in fire extinguisher is provided-

(1) Each built-in fire extinguishing system must be installed so that:

(i) No extinguishing agent likely to enter personnel compartments will be hazardous to the occupants; and

(ii) No discharge of the extinguisher can cause structural damage.

(2) The capacity of each required built-in fire extinguishing system must be adequate for any fire likely to occur anywhere in the compartment where used, considering the volume of the compartment and the ventilation rate. (see AMC 25.851(b)).

Book 1
SUBPART F EQUIPMENT

4. Revise CS 25.1439 to read :

CS 25.1439 Protective breathing equipment

(a) Fixed (stationary, or built in) protective breathing equipment must be installed for the use of the flight crew, and at least one portable protective breathing equipment shall be located at or near the flight deck for use by a flight crew member. In addition, portable protective breathing equipment must be installed for the use of appropriate crew members for fighting fires in compartments accessible in flight. This includes isolated compartments, upper and lower lobe galleys, in which crew member occupancy is permitted during flight. Equipment must be installed for the maximum number of crew members expected to be in the area during any operation. ~~Protective breathing equipment must be installed for use of appropriate crewmembers. Such equipment must be located so as to be available for use in compartments accessible in flight.~~

(b) For protective breathing equipment required by sub-paragraph (a) of this paragraph ~~CS 25.1439(a)~~ or by the applicable Operating Regulations, the following apply:

(1) The equipment must be designed to protect the appropriate crew member from smoke, carbon dioxide, and other harmful gases while on flight deck duty or while combating fires.

(2) The equipment must include:

(i) Masks covering the eyes, nose and mouth, or

(ii) Masks covering the nose and mouth, plus accessory equipment to cover the eyes.

(3) Equipment, including portable equipment, must allow communication with other crew members while in use. Equipment available at flight crew assigned duty stations must also enable the flight crew to use radio equipment.

(4) The part of the equipment protecting the eyes must not cause any appreciable adverse effect on vision and must allow corrective glasses to be worn.

(5) The equipment must supply protective oxygen of 15 minutes duration per crew member at a pressure altitude of 2438m (8 000ft) with a respiratory minute volume of 30 litres per minute BTPD. The equipment and system must be designed to prevent any inward leakage to the inside of the device and prevent any outward leakage causing significant increase in the oxygen content of the local ambient atmosphere. If a demand oxygen system is used, a supply of 300 litres of free oxygen at 21°C (70°F) and 760 mm Hg pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. If a continuous flow protective breathing system is used (including a closed circuit re-breather type system) a flow rate of 60 litres per minute at 2438 m (8 000 ft) (45 litres per minute at sea level) and a supply of 600 litres of free oxygen at 21°C (70°F) and 204 kPa (760 mm Hg) pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. Continuous flow systems must not increase the ambient oxygen content of the local atmosphere above that of demand systems. BTPD refers to body temperature conditions, that is 37°C (99°F), at ambient pressure, dry. ~~(See AMC 25.1439(b)(5))~~

(6) The equipment must meet the requirements of CS 25.1441.

<u>5. Revise CS 25.1453 to read :</u>

CS 25.1453 Protection of oxygen equipment from rupture
~~(See AMC 25.1453)~~

(a) Each element of the system, excluding chemical oxygen generators, must have sufficient strength to withstand the maximum working pressures and temperatures in combination with any externally applied load, arising from consideration of limit structural loads that may be acting on that part of the system in service.

(1) The maximum working pressure must include the maximum normal operating pressure, the transient and surge pressures, tolerances of any pressure limiting means and possible pressure variations in the normal operating modes. Transient or surge pressures need not be considered except where these exceed the maximum normal operating pressure multiplied by 1·10.

(2) Account must be taken of the effects of temperature up to the maximum anticipated temperature to which the system may be subjected.

(3) Strength demonstration using proof pressure and burst pressure coefficients specified in Table 1 is acceptable, unless higher stresses result when elements are subjected to combined pressure, temperature and structural loads.

(i) The proof and burst factors in Table 1 must be applied to maximum working pressure obtained from sub-paragraph (a)(1) with consideration given to the temperature of sub-paragraph (a)(2).

(ii) Proof pressure must be held for a minimum of 2 minutes and must not cause any leakage or permanent distortion.

(iii) Burst pressure must be held for a minimum of 1 minute and must not cause rupture but some distortion is allowed.

TABLE 1

Systems Element	**Proof Factor**	**Burst Factor**
Cylinders (i.e. pressure vessels)	1·5	2·0
Flexible hoses	2·0	4·0
Pipes and couplings	1·5	3·0
Other components	1·5	2·0

(b) Oxygen pressure sources and tubing ~~pipe lines~~ between the sources and shut-off means must be:

(1) Protected from unsafe temperatures, and

(2) Located where the probability and hazard of rupture in a crash landing are minimised.

(c) Parts of the system subjected to high oxygen pressure must be kept to a minimum and must be remote from occupied compartments to the extent practicable. Where such parts are installed within occupied compartments they must be protected from accidental damage.

(d) Each pressure source (e.g. tanks or cylinders) must be provided with a protective device (e.g. rupture disc). Such devices must prevent the pressure from exceeding the maximum working pressure multiplied by 1·5.

(e) Pressure limiting devices (e.g. relief valves), provided to protect parts of the system from excessive pressure, must prevent the pressures from exceeding the applicable maximum working pressure multiplied by 1·33 in the event of malfunction of the normal pressure controlling means (e.g. pressure reducing valve).

(f) The discharge from each protective device and pressure limiting device must be vented overboard in such a manner as to preclude blockage by ice or contamination, unless it can be shown that no hazard exists by its discharge within the compartment in which it is installed. In assessing whether such hazard exists consideration must be given to the quantity and discharge rate of the oxygen released, the volume of the compartment into which it is discharging, the rate of ventilation within the compartment and the fire risk due to the installation of any potentially flammable fluid systems within the compartment.

Book 2
AMC - SUBPART D

6. Delete existing AMCs 25.729(e) & 25.729(f).

7. Introduce a new AMC 25.729 to read :

AMC 25.729

Retracting Mechanism

1. PURPOSE. This Acceptable Means of Compliance (AMC) provides guidance material for use as an acceptable means of demonstrating compliance with the landing gear retracting mechanism requirements of the Certification Specification (CS) for large aeroplanes.

2. RELATED DOCUMENTS.

a. *Related Certification Specifications.* CS 25.729 and other paragraphs relating to landing gear retracting mechanism installations together with their applicable AMCs, if any. Paragraphs which prescribe requirements for the design, substantiation, and certification of landing gear retracting mechanisms include:

CS 25.111	Take-off path
CS 25.301	Loads
CS25.303	Factor of safety
CS 25.305	Strength and deformation
CS 25.307	Proof of structure
CS 25.333	Flight envelope
CS 25.471	General [Ground loads]
CS 25.561	General [Emergency Landing Conditions]
CS 25.601	General [Design and Construction]
CS 25.603	Materials
CS 25.605	Fabrication methods
CS 25.607	Fasteners
CS 25.609	Protection of structure

CS 25.613	Material strength properties
CS 25.619	Special factors
CS 25.621	Casting factors
CS 25.623	Bearing factors
CS 25.625	Fitting factors
CS 25.729	Retracting mechanism
CS 25.777	Cockpit controls
CS 25.779	Motion and effect of cockpit controls
CS 25.781	Cockpit control knob shape
CS 25.863	Flammable fluid fire protection
CS 25.869	Fire protection: systems
CS 25.899	Electrical bonding, etc.
CS 25.1301	Function and installation
CS 25.1309	Equipment, systems and installations
CS 25.1315	Negative acceleration
CS 25.1316	System lightning protection
CS 25.1322	Warning, caution and advisory lights
CS 25.1353	Electrical equipment and installations
CS 25.1357	Circuit protective devices
CS 25.1360	Precautions against injury
CS 25.1435	Hydraulic systems
CS 25.1515	Landing gear speeds
CS 25.1555	Control markings
CS 25.1583	Operating limitations
CS 25.1585	Operating procedures

b. FAA *Advisory Circulars (AC's).*

AC 20-34D	Prevention of Retractable Landing Gear Failures
AC 23.17	Systems and Equipment Guide for Certification of Part 23 Aeroplanes
AC 25.1309-1A	System Design and Analysis
AC 25-7A	Flight Test Guide for Certification of Transport Category Aeroplanes
AC 25-22	Certification of Transport Aeroplane Mechanical Systems
AC 43.13-1B	Acceptable Methods, Techniques and Practices - Aircraft Inspection and Repair.

c. *Federal Aviation Administration Orders.*

Order 8110.4A	Type Certification Process

Advisory Circulars and FAA Orders can be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, SVC-121.23, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

d. *Society of Automotive Engineers (SAE) Documents.*

SAE AIR-4566	Crashworthiness Landing Gear Design
SAE ARP-1311A	Landing Gear - Aircraft
ISO 7137	Environmental Conditions and Test Procedures for Airborne Equipment (not an SAE document but is available from the SAE)

These documents can be obtained from the Society of Automotive Engineers, Inc., 400

Commonwealth Drive, Warrendale, Pennsylvania, 15096.

e. *Industry Documents.*

(1) EUROCAE ED-14D/RTCA, Inc., Document No. DO-160D, Environmental Conditions and Test Procedures for Airborne Equipment.

(2) EUROCAE ED-12B/RTCA, Inc., Document No. DO-178B, Software Considerations in Airborne Systems and Equipment Certification.

These documents can be obtained from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 15, France

f. *Military Documents.*

MIL-STD-810 Environmental Test Methods and Engineering Guidelines

This document can be obtained from the Department of Defence, DODSSP, Standardisation Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

4. DISCUSSION.

a. *Intent of rule.* (Reference CS 25.729 Retracting mechanism)
This rule provides minimum design and certification requirements for landing gear actuation systems to address:

(1) Structural integrity for the nose and main landing gear, retracting mechanism(s), doors, gear supporting structure for loads imposed during flight;
(2) Positive locking of the kinematic mechanisms;
(3) Redundant means of extending the landing gear;
(4) Demonstration of proper operation by test;
(5) Gear up-and-locked and down-and-locked position indications and aural warning;
(6) Equipment damage from tyre burst, loose tread, and wheel brake temperatures.

b. *Demonstration of retracting mechanism proper functioning.* (Reference CS 25.729(d) Operation test)

Guidance addressing flight testing used to demonstrate compliance with this paragraph may be found in EASA AMC equivalent to FAA Advisory Circular (AC) 25-7A, Flight Test Guide for Transport Category Aeroplanes, chapter 4, section 4, paragraph 52, issued June 3, 1999.

c. *Retracting mechanism Indication.* (Reference CS 25.729(e) Position indicator and warning device)

(1) When light indicators are used, they should be arranged so that-
(i) A green light for each unit is illuminated only when the unit is secured in the correct landing position.
(ii) A warning light consistent with CS 25.1322 is illuminated at all times except when the landing gear and its doors are secured in the landing or retracted position.

(2) The warning required by CS 25.729(e)(2) should preferably operate whatever the

position of wing leading- or trailing-edge devices or the number of engines operating.

(3) The design should be such that nuisance activation of the warning is minimised, for example-

(i) When the landing gear is retracted after a take-off following an engine failure, or during a take-off when a common flap setting is used for take-off and landing;

(ii) When the throttles are closed in a normal descent; or

(iii) When flying at low altitude in clean or low speed configuration (special operation).

(4) Inhibition of the warning above a safe altitude out of final approach phase either automatically or by some other means to prevent these situations is acceptable, but it should automatically reset for a further approach.

(5) Means to de-activate the warning required by CS 25.729(e) may be installed for use in abnormal or emergency conditions provided that it is not readily available to the flight crew, i.e. the control device is protected against inadvertent actuation by the flight crew and its de-activated state is obvious to the flight crew.

d. *Protection of equipment on landing gear and in wheel wells.* (Reference CS 25.729(f) Protection of equipment on landing gear and in wheel wells)
The use of fusible plugs in the wheels is not a complete safeguard against damage due to tyre explosion.
Where brake overheating could be damaging to the structure of, or equipment in, the wheel wells, an indication of brake temperature should be provided to warn the pilot.

e. *Definitions.* For definitions of V_{SR} and V_C, see CS-Definitions 2, titled Abbreviations and symbols.

8. **<u>Delete existing AMC 25.773(b)(1)(ii) and introduce a new AMC 25.773 to read:</u>**

AMC 25.773

Pilot compartment view

The FAA Advisory Circular AC 25-773-1 : Pilot Compartment View Design Considerations (January 8, 1993), is accepted by the EASA as providing acceptable means of compliance with CS 25.773.

9. **<u>Introduce a new AMC 25.851(b) to read :</u>**

AMC 25.851(b)

Built-in Fire Extinguishers

1. <u>PURPOSE</u>.

This AMC sets forth acceptable means, but not the only means, of demonstrating compliance with the provisions of CS-25 related to the built-in fire suppression systems when required for cargo compartments of large aeroplanes. The guidance provided within this AMC has been found acceptable for showing compliance with the provisions of CS 25.855 and 25.857 for built-in fire extinguishing systems. As with all AMC material, it is not mandatory and does not constitute a regulation. For application to the product, alternate methods may be elected to be followed, provided that these methods are also found by the EASA to be an acceptable means of complying with the requirements of CS-25.

2. RELATED CS PARAGRAPHS.

CS 25.851 "Fire extinguishers"
CS 25.855 "Cargo or baggage compartments"
CS 25.857 "Cargo compartment classification”
CS 25.858 "Cargo compartment fire detection systems”

3. RESERVED.

4. BACKGROUND.

Minimal written guidance is available for use in certifying cargo compartment fire extinguishing or suppression systems. Testing at the FAA Technical Center and other data from standardised fire extinguishing evaluation tests indicates that the use of averaging techniques may not substantiate that there are adequate concentration levels of fire extinguishing agent throughout the compartment to effectively suppress a cargo fire.

Cargo fire extinguishing systems installed in aeroplanes today primarily use Halon 1301 as the fire suppression agent. One widely used method to certify Halon 1301 cargo fire suppression systems requires an initial concentration of five percent by volume in order to knock down a cargo fire. Subsequent concentration levels should not drop below three percent by volume for the remainder of the flight in order to suppress a cargo fire until it can be completely extinguished by ground personnel following a safe landing.

Since Halon 1301 is approximately five times heavier than air, it tends to stratify and settle after it is released into the cargo compartment. Also, due to temperature differences and ventilation patterns, in a ventilated compartment, Halon 1301 will start to stratify shortly after discharge and the concentration level will decay faster in the upper locations of the compartment than in the lower locations. Halon 1301 will also have a tendency to move aft due to any upward pitch or forward in any downward pitch of the aeroplane in flight. For some products the concentration levels of Halon 1301 have been measured at various locations throughout the cargo compartment and used an arithmetic average of the individual sampling locations to determine an overall concentration level for the cargo compartment. This averaging technique may allow the concentration level to drop below three percent by volume at individual sampling locations near the top of the cargo compartment.

Testing at the FAA Technical Center and other data from standardised fire extinguishing evaluation tests indicates that the use of averaging techniques may not substantiate that there are adequate concentration levels of fire extinguishing agent throughout the compartment to effectively suppress a cargo fire. If a cargo fire occurred, and was subsequently suppressed by Halon 1301, the core of the fire could remain hot for a period of time. If the local concentration of Halon 1301 in the vicinity of the fire core dropped below three percent by volume and sufficient oxygen is available, re-ignition could occur. The FAA tests have shown that when the Halon 1301 concentration level drops below three percent by volume and the cargo fire re-ignites, the convective stirring caused by the heat of the fire may be insufficient to raise the local concentration of Halon in the vicinity of the fire. Therefore, compliance testing will require the use of point-concentration data from each sensor and that the probes closest to the cargo compartment ceiling must be at least at the highest level that cargo and baggage can be loaded as specified by the manufacturer and certified by the appropriate airworthiness authority. In addition, certification test data acquisition must include analysis and/or data taken after landing at a time increment which represents the completion of an evacuation.

5. COMPARTMENT CLASSIFICATION.

All cargo compartments must be properly classified in accordance with CS 25.857 and meet the requirements of CS 25.857 pertaining to the particular class involved. In order to establish appropriate requirements for fire protection, a system for classification of cargo or baggage compartments was developed and adopted for large aeroplanes. Classes A, B, and C were initially established; Classes D and E were added later.

a. A Class A compartment is one that is located so close to the station of a crewmember that the crewmember would discover the presence of a fire *immediately*. In addition, each part of the compartment is easily accessible so that the crewmember could quickly extinguish a fire with a portable fire extinguisher. A Class A compartment is not required to have a liner.

(1) Typically, a Class A compartment is a small open compartment in the cockpit area used for storage of crew luggage. A Class A compartment is not, however, limited to such use; it may be located in the passenger cabin and used for other purposes provided it is located adjacent to a crewmember's station and crewmember remains present during all times when it is used for storage.

(2) Because a Class A compartment does not have a liner, it is *absolutely essential* that the compartment be small and located close enough to a crewmember that any fire that might occur could be discovered and extinguished immediately. Without a liner to contain it, an undetected or uncontrolled fire could quickly become catastrophic by burning out of the compartment and spreading throughout the aeroplane. All portions of the compartment must be within arms length of the crewmember in order for any fire to be detected immediately and extinguished in a timely manner. Although there may be some exceptions, such as a 'U-Shaped' compartment for example, a Class A compartment greater than 1.42 (50 cubic feet) in volume would not typically have the accessibility required by CS 25.857(a)(2) for fighting a fire.

b. A Class B compartment is one that is more remote than a Class A compartment and must, therefore, incorporate a fire or smoke detection system to give warning at the pilot or flight engineer station. Because a fire could not be detected and extinguished as quickly, a Class B compartment must have a liner in accordance with CS 25.855. A Class B cargo or baggage compartment has sufficient access in flight to enable a crewmember to reach all parts of the compartment with the contents of a hand fire extinguisher. There are means to ensure that, while the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent will enter areas occupied by the crew or passengers.

c. A Class C compartment differs from a Class B compartment in that it is not required to be accessible in flight and must, therefore, have a built-in fire extinguishing system to suppress or control any fire occurring therein. A Class C compartment must have a liner and a fire or smoke detection system in accordance with CS 25.855 and 25.857. There must also be a means to control ventilation and drafts within the compartment and a means to exclude hazardous quantities of smoke, flames, or extinguishing agent from occupied areas.

d. FAR Amendment 25-93 removed the Class D cargo compartment classification for new aeroplanes effective March 19, 1998.

e. A Class E compartment is particular to an all-cargo aeroplane. Typically, a Class E compartment is the entire cabin of an all-cargo aeroplane; however, other compartments of such aeroplanes may be classified as Class E compartments. A fire in a Class E compartment is controlled by shutting off the ventilating airflow to or within the compartment. Additionally, most cargo aeroplanes have smoke/fire procedures that recommend that the crew turn off the ventilating air, don their oxygen equipment, and gradually raise the cabin altitude, between 6096 m (20,000 feet) and 7620 m (25,000 feet), to limit the oxygen supply and help control a fire until the aeroplane can descend to land. A Class E compartment must have a liner and a fire or smoke detection system installed in accordance with CS 25.855; however, it is not required to have a built-in fire suppression system.

Classification of Class F cargo compartments.

f. A Class F cargo compartment is a proposed new cargo compartment of an aeroplane used only for the carriage of cargo. To address new “combi” designs, the FAA Transport Aeroplane Directorate (TAD) is proposing a revision to FAR 25.855 and 25.857 which would require Class B cargo compartments to be sufficiently small such that a crewmember with a hand held fire extinguisher can extinguish a fire anywhere within the compartment without entering it. A new cargo compartment, classified as Class F, is proposed and would not be size-limited. However, it would require a liner and detector, and incorporation of a means to extinguish or control the fire without the need for a crewmember to enter the compartment.

6. <u>FIRE EXTINGUISHING OR SUPPRESSION SYSTEMS</u>.

The terms “extinguishing system” and “suppression system” will be used interchangeably in this AMC. The system is not required to extinguish a fire in its entirety. The system is intended, instead, to suppress a fire until it can be completely extinguished by ground personnel following a safe landing.

7. <u>TESTING VOLUMETRIC CONCENTRATION LEVELS</u>.

For the product it should be demonstrated that the cargo fire extinguishing system provides adequate concentration levels of extinguishing agent to combat a fire anywhere where baggage and cargo is placed within the cargo compartment for the time duration required to land and evacuate the aeroplane. A combination of flight-testing and analysis may be used to comply with this requirement. If Halon 1301 is used, an initial minimum concentration of five percent by volume is required to knock down a cargo fire. Subsequent gaseous extinguishing agent should, if required for the duration of the flight, be introduced via a metering or other appropriate system to ensure that point concentration levels do not drop below three percent by volume for the remainder of the flight. The duration of agent application should be determined from route analysis (i.e. the time to travel from the farthest distance expected in route to the nearest adequate airport for landing per applicable operational rules. For Extended Operation with Two-Engine Aeroplanes (ETOPS) AMC 20-6 specify that an analysis or tests should be conducted to show, considering approved maximum diversion in still air (including an allowance for 15-minute holding and/or approach and land), that the ability of the system to suppress or extinguish fires is adequate to ensure safe flight and landing at a suitable airport. The minimum extinguishing agent concentration levels are to be maintained for the required duration throughout the cargo compartment where cargo will be carried, including side to side, end to end, and top to bottom. However, flight test measurements do not have to be made in compartment areas that are designated empty and will not contain cargo.

The fire extinguishing agent concentration levels should be measured at sufficient vertical horizontal, and longitudinal locations to ensure that sufficient resolution exists to define the variations in fire extinguishing agent concentration levels throughout the cargo compartment in these planes. No averaging techniques are permitted in compliance demonstrations for CS 25.851(b)(2). The only exception to this will be in the event of a sensor failure where interpolation of sensor data from other nearby probes to yield an estimate of missing agent concentration data may be allowed by the Agency. In the event such interpolation is necessary, then a linear interpolation of the data will provide an acceptable means of approximating the missing data.

Sampling locations should also be placed as close as practical to potential leakage or ventilation flow areas (e.g., door seals, vents, etc.) which can disrupt the local concentration levels.

The concentration levels should not be less than the minimum established for that fire extinguishing agent at any point within the compartment. Arithmetic averaging of individual sampling locations to determine the concentration levels is not acceptable. The use of averaged concentration data will no longer be accepted, except in well-defined cases (i.e., during certification tests) where a sensor probe failure occurs and the use of interpolation from adjacent sensor probes is warranted. Compliance with CS 25.851(b) will require the use of point-concentration data from each sensor and that the probes closest to the cargo compartment ceiling must be at least at the highest level that cargo and baggage can be loaded as specified by the manufacturer and certified by the Agency. Other placement of concentration sensor probes within the cargo compartment should be sufficient to substantiate that there are adequate concentration levels of fire extinguishing agent throughout the compartment to effectively control a cargo compartment fire. The sampling rate should be sufficient to establish a concentration level versus time decay curve. In the event that a single sensor displays a suspect time history, the use of an interpolated time averaged value may be acceptable to the Agency. If fire extinguishing agent concentration levels at a probe drop below the minimum requirement, it should be a temporary anomaly of short duration and not observed in adjacent probes. If it could be demonstrated that the temporary anomaly is associated with aeroplane manoeuvres, then the data may be acceptable to the Agency.

Typically there are two type of extinguishing agent dispensing systems, a flood or dump (high rate discharge) system and a metered system. The flood or dump system dispenses the agent with the activation of the system and a selected amount of agent is injected into the compartment to suppress the fire. Once the agent concentration level approaches the minimum sustaining level, i.e., 3%, a second and subsequent discharge of agent takes place to assure the 3% concentration level is maintained for the time necessary to divert to a safe landing. The metered systems usually discharge agent into the compartment for fire suppression (5%) and then adds agent in a prescribed amount to the compartment to maintain the 3% concentration level.

Certification flight test demonstration is required for a “dump” system for the duration of the intended diversion profile. If a metering system is proposed, the system’s acceptability may be demonstrated through a limited flight test, in which a portion of the system is actually tested, and the full capability of the system is demonstrated via analysis. It is recognised that issues such as what compartment size should be tested (smallest or largest), the test duration in flight, and whether reliable analytical methods are available to predict concentration levels for various locations and heights in a given cargo compartment will have an impact on certification tests. EASA concurrence must be obtained for this type of testing and analysis of the product. A sufficient portion of the metering system capability should be demonstrated to provide enough data to establish fire extinguishing agent concentration and behaviour for the remaining flight. It is recognised that aeroplane climb flight phase and the descent flight phase represent dynamic environments and no data need be acquired during these transient flight phases were cabin altitude changes would preclude accurate data acquisition. However, certification data must include analysis and/or data taken after landing at a time increment representative of the completion of an evacuation of all occupants.

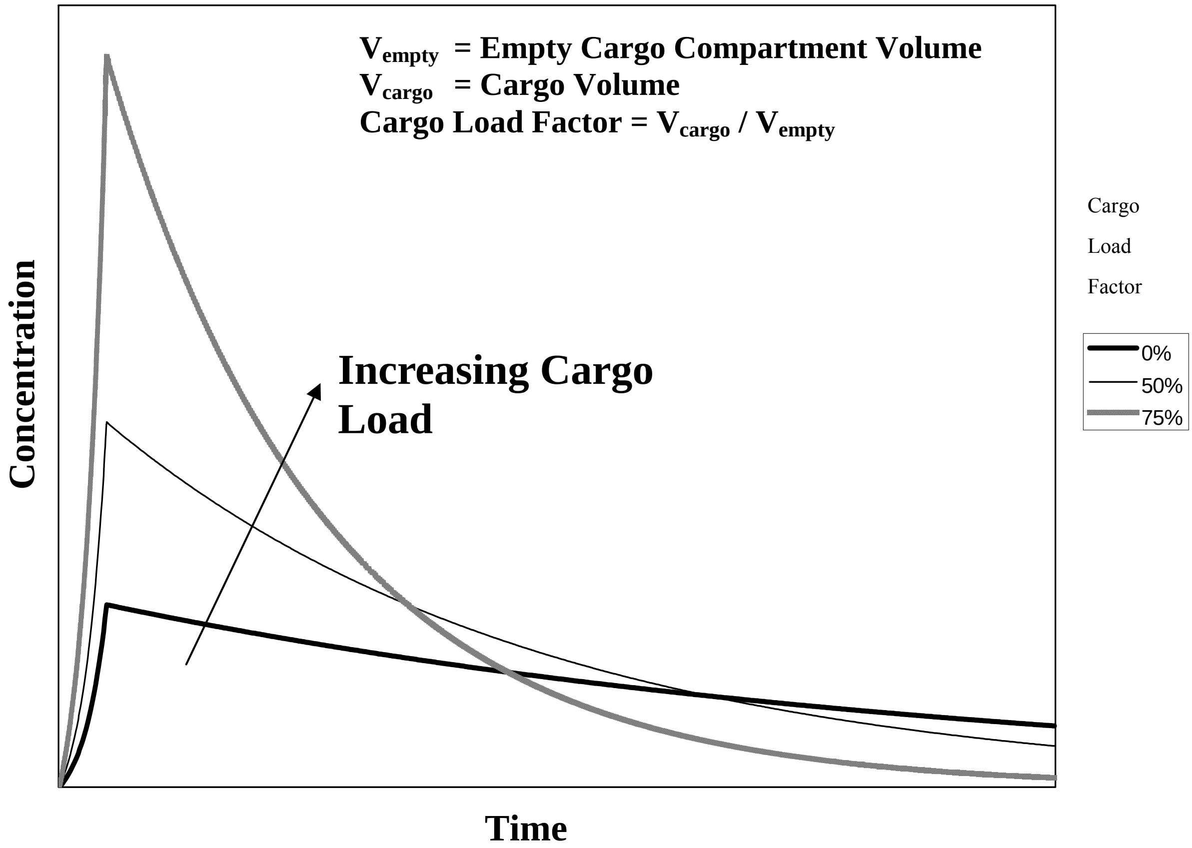
If it is proposed for a product to use a fire extinguishing agent other than Halon 1301, the Agency should be contacted. The EASA will initiate a Certification Review Item addressing the use of an alternate fire extinguishing agent.

8. <u>AEROPLANE TEST CONDITIONS.</u>

Flight tests are required to demonstrate function and dissipation of the fire extinguishing agent or simulant in a cargo compartment. For certification tests, the aeroplane and relevant systems should be in the type design configuration.

The cargo compartment should be empty for the above test. However, as shown in Figure 8-1, a compartment with cargo may be more time critical than an empty compartment for minimum fire extinguishing agent concentration levels. The time critical nature depends on several factors. Even with a pure “dump” system, having cargo does not necessarily mean a marginally performing system during an empty cargo compartment test will result in a “bad” system with cargo. Also, metering systems, if designed properly, are relatively insensitive to the cargo load factor.

Figure 8-1. Effect of Cargo Load on Halon 1301 Concentration Levels



A specific example of the effect of cargo compartment loading is shown in Figure 8-2, using the Appendix 1 simulation. If the volume of the compartment is decreased to represent increasing cargo load percentages and the leakage rate and initial Halon quantity are kept constant, then the initial Halon concentrations increase and the concentration decay rates also increase. Using this approach, the concentration in an empty compartment will decay to 3% faster than a loaded compartment up to a load percentage of about 65.6%. With compartments loaded to a higher percentage than 65.6%, the concentration will fall below 3% faster than an empty compartment.

This simulation of cargo loading assumes that the Halon concentration is homogeneous throughout the compartment and that the volume taken up by the loaded cargo is uniformly distributed throughout the compartment. Note: Both of these assumptions are not true in an actual loaded compartment so caution should be exercised to relate the measurements taken in an actual loaded compartment in flight.

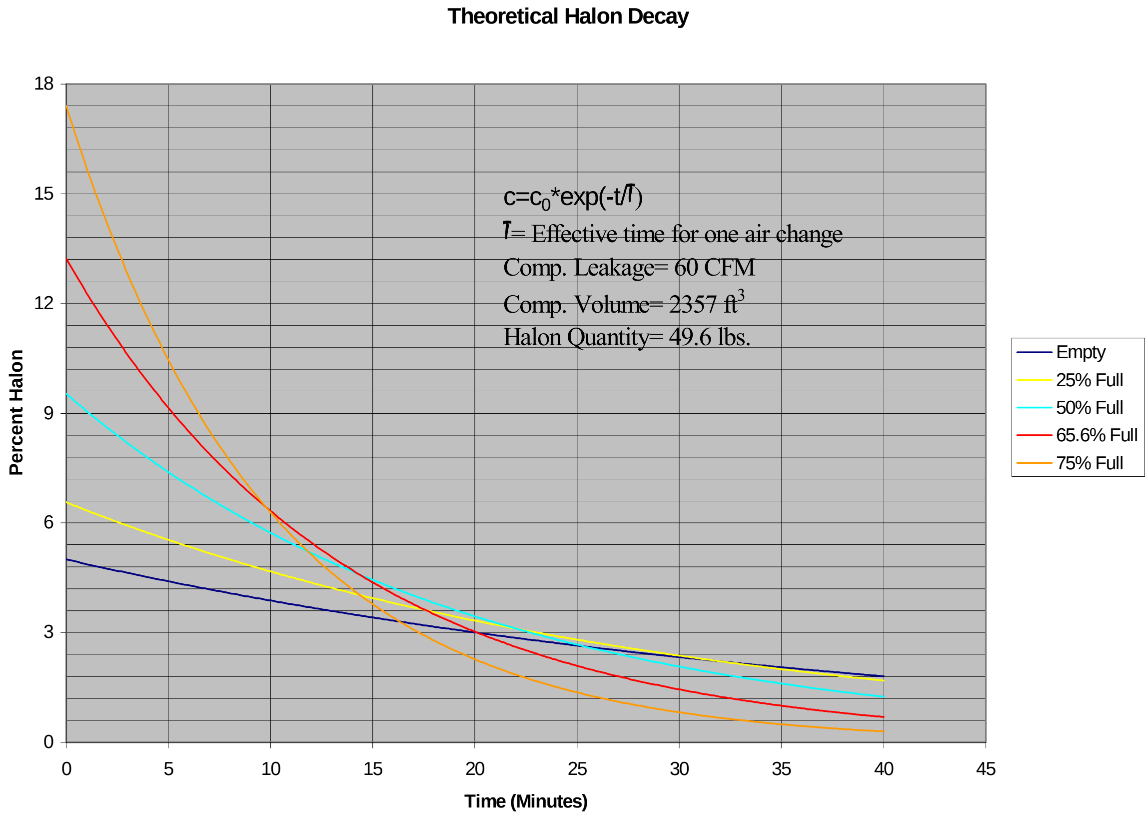


Figure 8-2

Analysis should be provided to ensure that the suppression agent concentration levels will not fall below the minimum requirement with a cargo load factor as follows:

a. For cargo compartments using only standard cargo containers, the maximum possible volume occupied by containerised cargo should be determined for the product and this value be used as the cargo load factor. This maximum volume becomes an aeroplane limitation.

b. For all other configurations, a minimum cargo load factor of 75% by volume should be used for the product."

Appendix 1 to this AMC provides guidance on analysing Halon 1301 concentration levels.

The suppression system certification test should be conducted, as a minimum, during steady-state cruise with a maximum cabin-to-ambient pressure differential. The ventilation system should be configured per the aeroplane flight manual (AFM) procedures for a cargo compartment fire. The system should also be demonstrated acceptable for unpressurised flight conditions unless there is a restriction on unpressurised flight for the aeroplane.

It should be noted that cargo compartment leakage rates would vary between aeroplanes. This is especially significant for changes introduced by supplemental type certificate (STC) modifying aeroplanes that have been in service. Some preliminary testing should be done to determine the maximum leakage rates seen/expected in service. For new type designs the issue of wear and tear on the compartment should also be addressed when establishing the decay rate in a brand new aircraft at the factory.

9. EVALUATION OF ALTERNATE GASEOUS EXTINGUISHING/SUPPRESSION SYSTEMS AND ALTERNATE AGENTS

The Montreal Protocol, in existence since 1987, is an international agreement to phase out production of ozone-depleting substances, including halogenated hydrocarbons also known as Halon. The Montreal Protocol prohibits the manufacture or import of new Halon in all developed countries as of January 1, 1994, and will extend this prohibition to developing countries in the future. The Environmental Protection Agency (EPA) has subsequently released a regulation banning the intentional release of Halons during repair, testing, and disposal of equipment containing Halons and during technician training. However, the EPA has provided the aviation industry an exemption from their ban on the intentional release of Halons in determining compliance with EASA Airworthiness Standards. It should be noted that the EPA exemption is predicated on the basis that there is currently no suitable alternate agent or system available for use on commercial transport category aeroplanes. It is the understanding of the EASA that once a suitable replacement extinguishing agent or system has been found then the EPA will remove the exemption.

To date, FAA Technical Center testing of alternate gaseous extinguishing/suppression agents has not yielded any acceptable alternate Halon replacement agents for use in cargo compartments. For example, testing at the Technical Center utilising HFC-125 demonstrated the need for large concentrations of this agent that would carry weight penalty and toxicity concerns. The Technical Center will continue to pursue this line of research to identify alternate gaseous and liquid and other fire extinguishing / suppression agent systems. Acceptable means of compliance for these immature systems are beyond the scope of this AMC. Future revisions to this AMC will be accomplished as soon as suitable standards are developed for these systems.

Should the EASA be approached with the intent of utilising for the product an alternate agent or alternate gaseous fire extinguishing system in lieu of a Halon 1301 system, then the recommended approach would be to perform testing on the product which meets the Minimum Performance Standards for that application as developed by the International Halon Replacement Working Group. The International Halon Replacement Working Group was established in October 1993. This group was tasked to work towards the development of minimum performance standards and test methodologies for non-Halon aircraft fire suppression agents/systems in cargo compartments, engine nacelles, hand held extinguishers, and lavatory trash receptacles. The International Halon Replacement Working Group has been expanded to include all system fire protection R&D for aircraft and now carries the name, International Aircraft Systems Fire Protection Working Group.

To ensure acceptable means of compliance, the following must be provided :

a. The test data and gaseous agent distribution profiles which meet the certification criteria as expressed below and in the Minimum Performance Standards as developed by FAA Technical Center as part of the International Halon Replacement program. (See paragraph 15 for the listing of the references.)

b. A system description document that includes a description of the distribution of the gaseous agent under the test conditions in the cargo compartment.

c. A detailed test plan.

d. Chemical data which describes the agent and any toxicity data.

9.1 Pre-Test Considerations:

a. An EASA accepted analyser (for example, Statham-derivative analyser) capable of measuring the agent distribution profile in the form of volumetric concentration is required.

b. An EASA accepted analyser (for example, Statham-derivative analyser) and associated hardware are configured for the particular application.

c. The fire suppression system should be completely conformed prior to the test.

d. The fire extinguisher bottle(s) should be serviced and prepared for the prescribed test(s).

9.2 Test Procedures:

a. Perform the prescribed distribution test in accordance with the test plan approved by the Agency. See Paragraph 7 for guidance on probe placement.

b. An EASA accepted analyser (for example, Statham-derivative analyser) should record the distribution profile as volumetric concentration for the agent.

9.3 Test Result Evaluation:

a. Produce the data from the EASA accepted analyser (for example, Statham-derivative analyser) in graphical format. This format should be the volumetric concentration of the agent versus time. A specific percent volumetric initial concentration and a specific percent volumetric metered concentration for the length of the test duration as determined by previous testing conducted per the established minimum performance standards is required for airworthiness approval of cargo compartment systems.

b. Using the appropriate MPS evaluation criteria, evaluate the distribution profile of the agent for acceptable performance. The acceptability of the test data would be dependent upon the distribution profile and duration exhibited by each probe per (1) above and Paragraph 7 for cargo compartment fire extinguishing systems

10. <u>EVALUATION OF ALTERNATE LIQUID AGENT AND FIRE EXTINGUISHING/ SUPPRESSION SYSTEMS</u>

The FAA Technical Center has released a Technical Note that represents the latest Minimum Performance Standards (MPS) for a water spray system. However, as mentioned within the body of the report, additional developmental testing would be needed for the product and the FAA to be approached regarding certification of such a system. Additional testing would be required to demonstrate compliance with an Aerosol spray can fire threat. The Technical Center continues to perform research towards identifying alternate liquid and other fire extinguishing / suppression systems. Acceptable means of compliance for these immature systems are beyond the scope of this AMC. Future revisions to this AMC will be accomplished as soon as suitable standards are developed for these systems.

If for the product it is proposed to use a liquid fire extinguishing agent or system, the EASA should be contacted. The EASA will initiate a Certification Review Item addressing the use of an alternate fire extinguishing agent or system.

11. USE OF SIMULANTS FOR CERTIFICATION TESTING

The aviation industry may continue to use Halon in cargo fire suppression applications as long as acceptable alternatives have not been identified and shown to provide an equivalent level of safety. The EPA is allowing the aviation industry to use Halon to demonstrate system functionality as long as a simulant or alternate extinguishing agent or alternate fire extinguishing system cannot be used in place of the Halon during system or equipment testing for technical reasons. It should be noted, however, that certain states continue to ban the release of Halon for testing. The FAA Technical Center and the International Aircraft Systems Fire Protection Working Group are concentrating efforts on evaluating alternative fire extinguishing agents and the use of simulants during certification testing. The EASA plans to approve a simulant which can be used in place of Halon 1301 during certification tests of aircraft fire extinguishing systems to predict actual Halon 1301 volumetric concentration levels. When approved, use of a simulant will be the preferred method for demonstrating compliance.

As of the date of this AMC, no suitable simulant for cargo compartment gaseous fire extinguishing systems has been identified. However, should the EASA being approached with the intent of utilising for the product a simulant in lieu of a Halon 1301 system or other gaseous fire extinguishing system then the recommended approach would be to perform testing which meets the Minimum Performance Standards for that application as developed by the International Aircraft Systems Fire Protection Working Group. To ensure acceptable successful means of compliance the same information as outlined above in paragraph 7 should be provided.

A simulant is defined in this AMC as a chemical agent that adequately imitates the discharge and distribution characteristics of a given extinguishing agent. It need not be an actual fire suppressant. For certain cases due to cost of the extinguishing agent, problems with supply of the extinguishing agent, etc; it may be more appropriate for the application to utilise a simulant. The Agency would require adequate analysis and testing be accomplished to establish the validity of the simulant. As a minimum, corroborating information would need to be provided as to the detailed chemical analysis of the simulant and evaluation testing of the fire extinguishing system operated with the simulant which demonstrates the equivalent behaviour. To ensure acceptable means of compliance, the following must be provided:

(1) The test data and distribution profiles using the simulant which meet the certification criteria as expressed below and in the Minimum Performance Standards as developed by FAA Technical Center as part of the International Aircraft Systems Fire Protection Working Group. (See Paragraph 15 for the listing of the references.)

(2) A system description document that includes a description of the distribution of the simulant under the test conditions in the cargo compartment.

(3) A detailed test plan.

(4) Chemical data which describes the simulant and any toxicity data.

For the application the distribution of the simulant must be described as compared with Halon 1301 under the following conditions:

a. Given the same filling conditions, the simulant is loaded into the fire extinguisher bottle based on an equivalent liquid fraction to the Halon 1301 charge weight required. This is an equivalent statement to the mass of the simulant being a specific percentage of the Halon 1301 charge weight required.

b. The fire extinguisher bottle containing the simulant is pressurised with nitrogen in an identical manner required by the Halon 1301 charge weight.

c. The simulant is discharged into the test environment, i.e. cargo compartment.

11.1 Pre-Test Considerations:

a. An EASA accepted analyser (for example, Statham-derivative analyser) capable of measuring the simulant distribution profile in the form of volumetric concentration is required.

b. An EASA accepted analyser (for example, Statham-derivative analyser) and associated hardware are configured for the particular application.

c. The fire suppression system should be completely conformed for Halon 1301.

d. The fire extinguisher bottle(s) should be serviced and prepared for the prescribed test(s).

11.2 Test Procedures:

a. Perform the prescribed distribution test in accordance with the EASA approved test plan. See Paragraph 7 for guidance on probe placement.

b. An EASA accepted analyser (for example, Statham-derivative analyser) should record the distribution profile as volumetric concentration for the simulant.

11.3 Test Result Evaluation:

a. Produce the data from the EASA accepted analyser (for example, Statham-derivative analyser) in graphical format. This format should be the volumetric concentration of the simulant versus time. A specific percent volumetric initial concentration and a specific percent volumetric metered concentration for the length of the test duration as determined by previous testing conducted per the established minimum performance standards is required for airworthiness approval of cargo compartment systems.

b. Using the Halon 1301 certification criteria, evaluate the distribution profile of the simulant for acceptable performance. The acceptability of the test data would be dependent upon the distribution profile and duration exhibited by each probe (See above and Paragraph 7 for cargo compartment fire extinguishing systems).

12. ESTABLISHING DURATION FOR THE SUPPRESSION SYSTEM.

The adequacy of the capacity of the "built-in system" is understood to mean, that there is sufficient quantity of agent to combat the fire anywhere where baggage and cargo is placed within the cargo compartment for the time duration required to land and evacuate the aeroplane. Current built-in cargo fire extinguishing systems utilise Halon 1301 as the fire extinguishing agent. Protection is afforded as long as the minimum concentration levels in the cargo compartment do not drop below three percent by volume. The time for which a suppression system will maintain the minimum required concentration levels should be identified as a certificate limitation.

The designer of the product should work with the aircraft owner and the civil aviation authority providing operational approval to ensure that the cargo fire extinguishing system provides the required protection time (i.e., proper sizing of the cargo fire extinguishing system) for the specific route structure. The civil aviation authority may insist on some holding time to allow for weather and other possible delays, and may specify the speeds and altitudes used to calculate aeroplane diversion times based on one-engine-out considerations.

The civil aviation authority providing operational approval for the aeroplane determines the maximum allowable time, following the discovery of a fire or other emergency situation, required to divert the aeroplane to an alternate landing site. In the past, for some cases, the maximum allowable time was calculated by adding a 15 minute allowance for holding and/or approach and landing to the actual time required to reach the alternate landing site under specific operating conditions. With the issuance of this AMC, an allowance of 15 minute for approach and landing must be considered and certification data must include analysis and/or data taken after landing at a time increment which represents the completion of an evacuation of all occupants.

AMC 20-6 "Extended Range Operation with Two-Engine Aeroplanes (ETOPS)," provides acceptable means for obtaining approval under applicable operational rules for two-engine aeroplanes operating over a route that contains a point farther than one hour's flying time at the normal one-engine inoperative cruise speed (in still air) from an adequate airport. It includes specific criteria for deviations of 75 minutes, 120 minutes, and 180 minutes from an adequate airport plus an allowance for 15-minute holding and/or approach and land.

Certification flight tests, supplemented by analysis for cargo load factors and additional metering system bottles as applicable, determines the maximum protection time provided by the cargo fire extinguishing system. This maximum protection time may not be the same as the maximum allowable time required to divert the aeroplane. The certificate limitation for total time, including the 15 minute allowance for holding and/or approach and landing as applicable, should never be greater than the maximum protection time provided by the cargo fire extinguishing system.

The following examples illustrate these issues:

Example 1

Maximum protection time provided
By cargo fire extinguishing system = 127 minutes

Maximum diversion time = 112 minutes + 15 minutes

(Note - in this example, the civil aviation authority required an allowance of 15 minutes for holding and/or approach and landing)

Certificate limitation for total time = 127 minutes

Example 2

Maximum protection time provided
By cargo fire extinguishing system = 68 minutes

Maximum diversion time = 60 minutes

(Note - in this example, the civil aviation authority did not require the 15 minutes allowance for holding and/or approach and landing. With the issuance of this AMC, the approach indicated in example 2 above is no longer considered an acceptable means of compliance.)

Certificate limitation for total time = 60 minutes"

13. MANUAL CONSIDERATIONS.

To ensure fire protection/fire suppression system effectiveness and safe continuation of flight and landing, the applicable aeroplane manuals should contain appropriate directives, for example:

a. Any procedures related to fighting a cargo compartment fire should be clearly defined in the Aeroplane Flight Manual (AFM).

b. Aeroplane Flight Manuals should contain instructions to land at the nearest adequate airport (or suitable airport for ETOPS) following detection of a cargo fire.

c. Cargo loading restrictions (certified type of loading per compartment, limits for loading heights and width, etc.) should be clearly described in the Weight & Balance Manual or any other appropriate aeroplane manual.

d. Where the use of aeroplane manuals is considered to be impractical during cargo loading activities, all necessary information may be introduced into crew operating manuals or part of dedicated instructions for cargo loading personnel.

14. PLACARDS AND MARKINGS IN CARGO COMPARTMENTS

Experience has shown that under certain circumstances and despite clear instructions in the applicable aircraft documentation, cargo loading personnel may not obey loading restrictions. Especially pallets may be loaded higher than certified or bulk cargo may be stowed up to the ceiling, adversely affecting smoke detection and fire protection/fire suppression system effectiveness.

To visually indicate the applicable loading restrictions to each person being responsible for cargo loading activities in a compartment, placards and markings for certified type of cargo, maximum loading height and widths may need to be installed in that compartment.

For the design of these indications (i.e., for shape, size, colour and brightness), illumination conditions in the compartment should be considered. Markings and placards should not be easily erased, disfigured or obscured. Further guidance may be derived from compliance demonstrations for CS paragraphs regulating other internal markings and placards, for example in the cockpit or passenger compartment.

15. REFERENCES.

a. Report No. FAA-RD-71-68, Fire Extinguishing Methods for New Passenger Cargo Aircraft, dated November 1971.

b. Report No. DOT/FAA/AR-96/5, Evaluation of Large Class B Cargo Compartment's Fire Protection, dated June 1996.

c. Civil Aviation Authority (CAA) Paper 91003, Cargo Bay Fire Suppression, dated March 1991.

d. Report No. DOT/FAA/AR-00-28, Development of a Minimum Performance Standard for Aircraft Cargo Compartment Gaseous Fire Suppression Systems, dated September 2000.

e. Report No. DOT/FAA/AR-TN01/1, Water Spray as a Fire Suppression Agent for Aircraft Cargo Compartment Fires, dated March 2001.

APPENDIX 1. ANALYTICAL METHODS FOR DETERMINING HALON 1301 CONCENTRATION LEVELS

1. PURPOSE. This appendix contains analytical methods for determining Halon 1301 fire extinguishing agent concentration levels in empty or loaded cargo compartments as a function of time.

2. EXPLANATION OF TERMS AND SYMBOLS.

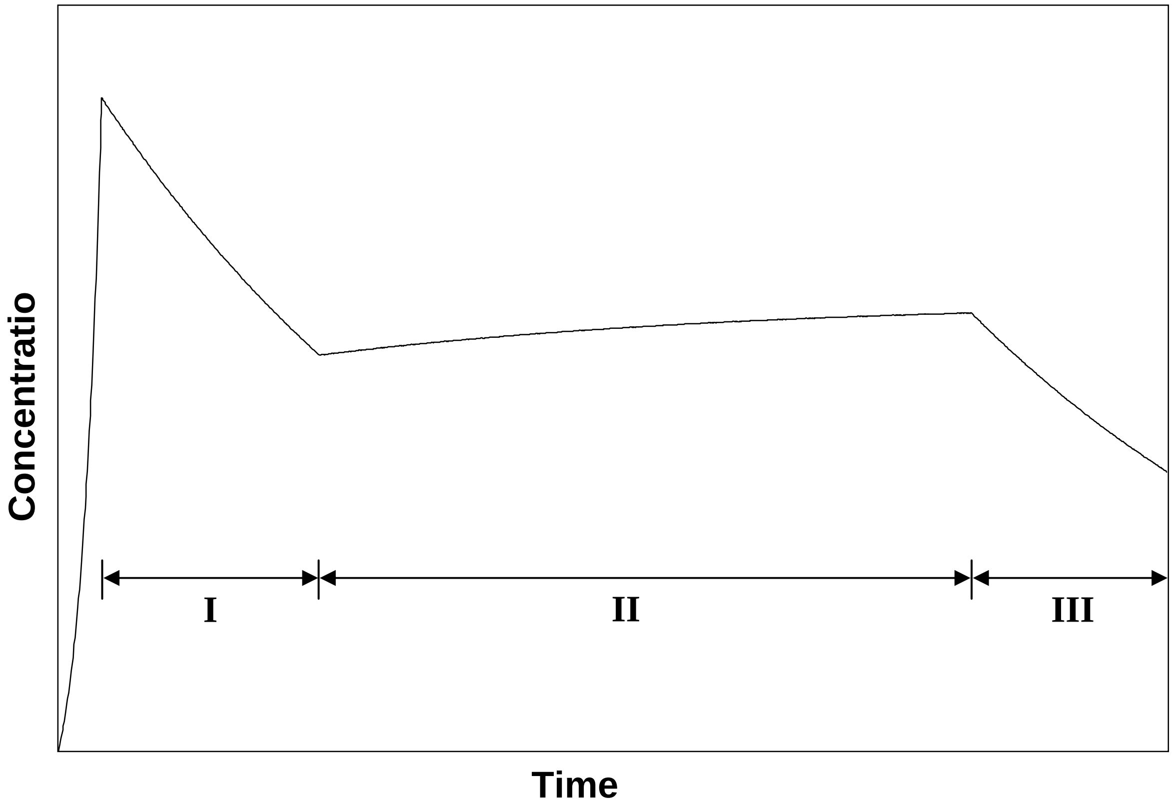
TABLE 2-1. TERMS AND SYMBOLS

SYMBOL	DESCRIPTION	UNITS CONSISTENT WITH EQUATIONS
C(t)	Halon 1301 concentration by volume at time "t." $= V_{Halon\ 1301} / V$	Dimensionless
$V_{Halon\ 1301}$	Volume of Halon 1301 in cargo compartment.	Cubic meter - m^3 (Cubic feet - ft^3)
V	Cargo compartment free volume (i.e., volume not occupied by cargo). $= 1 - (V_{cargo} / V_{empty})$	Cubic meter - m^3 (Cubic feet - ft^3)
V_{cargo}	Cargo volume.	Cubic meter - m^3 (Cubic feet - ft^3)
V_{empty}	Empty cargo compartment volume.	Cubic meter - m^3 (Cubic feet - ft^3)
t	Time.	Minutes – Min
E	Cargo compartment leakage rate.	Cubic meter per minute - m^3/min (Cubic feet per minute - ft^3/min)
S	Specific volume of Halon 1301.	Cubic meter per kilogram m^3/kg (cubic feet per pounds(mass) ft^3/lbm)
R	Halon 1301 flow rate.	Kilogram per minute kg/min (pounds(mass) per minute lbm/min)

3. HALON 1301 CONCENTRATION LEVEL MODEL.

Cargo compartment fire extinguishing systems generally use a combination of one or two types of Halon 1301 discharge methods. One type rapidly releases all of the fire extinguishing agent from one or more pressurised bottles into the cargo compartment. This type of discharge method is commonly known as a high rate discharge or 'dump' system.

FIGURE 3-1. EXAMPLE - HALON 1301 MODEL



The second type of Halon 1301 discharge method slowly releases the fire extinguishing agent from one or more pressurised bottles into the cargo compartment. This type of discharge method is commonly known as a metering system.

The following list provides some examples, not all-inclusive, of different combinations of these Halon 1301 discharge methods.

a. One high rate discharge.

b. One high rate discharge followed by a second high rate discharge at a specified later time.

c. One high rate discharge followed by a metered discharge at a specified later time.

d. Simultaneous high rate and metered discharges.

The Halon 1301 fire extinguishing system described in paragraph 3.c. above utilises both types of discharge methods and is illustrated in Figure 3-1.

Prior to Phase I - Initial High Rate Discharge of Halon 1301

This portion of the extinguishing process illustrates the high rate discharge method of releasing all of the fire extinguishing agent from one or more pressurised bottles into the cargo compartment.

Phase I - Exponential "Decay" of Halon 1301
The beginning of Phase I represents the initial concentration of Halon 1301 used to knock down a cargo fire. Since no more Halon 1301 is introduced into the cargo compartment during Phase I, the concentration of Halon 1301 undergoes an exponential "decay" versus time.

The governing equation for exponential "decay" during Phase I is the following:

$$\mathbf{C(t) = C(0)\ e^{-E\,t/V}}$$

NOTE - **C(0)** is the initial concentration of Halon 1301 used to knock down a cargo fire at the beginning of Phase I and **t** is the time elapsed since the beginning of Phase I.

Phase II - Metered Discharge of Halon 1301
The metered discharge of Halon 1301 starts at the beginning of Phase II. The example in Figure 3-1 shows that the metering rate is set to release Halon 1301 into the cargo compartment at a rate which is slightly greater than the rate Halon 1301 is lost through cargo compartment leakage.

The governing equation for metering during Phase II is the following:

$$\mathbf{C(t) = [\ C(0) - \{\ R\ S\ /\ E\ \}\ ]\ e^{-E\,t\,/\,V} + \{\ R\ S\ /\ E\ \}}$$

NOTE - **C(0)** is the concentration of Halon 1301 at the end of Phase I and **t** is the time elapsed since the end of Phase I.

Phase III - Exponential "Decay" of Halon 1301
The beginning of Phase III marks the end of Halon 1301 metering. As in Phase I, since no more Halon 1301 is introduced into the cargo compartment, the concentration of Halon 1301 undergoes an exponential "decay" versus time.

The governing equation for exponential "decay" during Phase III is the same as during Phase I with one exception; **C(0)** is the concentration of Halon 1301 at the end of Phase II and **t** is the time since the end of Phase II."

CS-25BOOK 2

AMC - SUBPART F

<u>10. Delete existing AMC 25.1439(b)(5).</u>

<u>11. Delete existing AMC 25.1453.</u>

III) ORIGINAL JAA NPA PROPOSALS JUSTIFICATION

Note: Where relevant references to JAA and JAR have been replaced by EASA and CS respectively.

The following is for comments and explanation for the changes. It covers all the CS-25 paragraphs to be reviewed with a justification for the changes, and also where applicable for CS-25 paragraphs where no action is taken.

CS 25.677 Trim Systems

CS 25.677(b) requirement establishes the minimum design standard for trim indication systems. The intent of this standard is to provide accurate direction and position indication in relation to the aeroplane motion to the flight crew when the trim system is in operation.
On the FAR side, the existing CS text has been added (amendment 25-115) to the Code of Federal Regulations 14 Part 25 as a new section 25.677(b). Based on this, both FAR and CS texts are identical, and no specific action is needed on the CS side.

CS 25.729 Retracting Mechanism

The proposed harmonised FAR/CS 25.729 text is basically enveloped on the existing CS text which is the most severe one. For the most part, the additional requirements in the CS simply emphasise what should be good design practice. Proposed advisory material was developed from the existing FAA AC and CS AMC material.

The following describes the differences for existing requirements and the origin of the new advisory material:

For the 25.729 rule text, main differences are as follows:

25.729(b) Landing gear lock
The CS additionally requires a positive means to keep the landing gear and doors in the correct retracted position unless extending the gear and doors at any flight speed is not hazardous.
This results in the need for uplock mechanisms that will function in the event that the primary retraction energy is lost, or in robust gear and door mechanisms that can withstand deployment at any flight speed. The requirement is not overly stringent since loss of primary retraction energy is an expected event. The uplock mechanism is preferred since extension of the landing gear will increase fuel consumption due to increased drag.

25.729(e) Position indicator and warning device
The CS refers to AMC 25.729(e). The CS further refines the definition of the indicator to:
Be easily visible to the pilot or appropriate crew members,
Indicate without ambiguity the position of the gear.
In addition the CS requires that the indicator also provide similar position information about the associated landing gear doors.
These additions simply state what should be intrinsic to any prudent landing gear indication design.

25.729(e)(5)
Regarding false or inappropriate alerts, the FAR uses the word “eliminate” while the CS uses the more practical word “minimise.”
If taken literally, the FAR requirement is overly stringent. While elimination of nuisance warnings is a worthy goal, it is virtually impossible to actually never have a nuisance warning unless the system is unable to provide any warning. The CS requirement is more subjective but attainable and embraces any improvements in warning system technology.

25.729(e)(7)
The FAR does not contain this sub-paragraph.
The sub-paragraph requires an indication if the landing gear position does not agree with the selector lever position. This is consistent with prudent landing gear indication design.

25.729(f) Protection of equipment from rolling stock threats
In addition to protection of equipment in the wheel well, the CS includes protection of equipment on the landing gear.
This results in analysis and protection of equipment that is not just in the wheel well but also on the landing gear either gear retracted or extended. This is reasonable since equipment on the lower part of the landing gear is always near the tyre and therefore should be considered.

25.729(f)(1) Tyre burst, loose tread
The CS deletes the FAR condition “unless it is shown that a tyre cannot burst from overheat” and refers to AMC 25.729(f) which states that wheel fuse plugs are not a complete means of compliance to protection of essential equipment from tyre burst.
This results in removal of two possible, however not very viable, compliance methods i.e. showing the tyre will not burst from overheat or the use of wheel fuse plugs.

25.729(f)(3) Brake temperature
The FAR does not contain this sub-paragraph. The CS requires protection of equipment from possible wheel brake temperatures and refers to AMC 25.729(f) which suggests an indication of brake temperature should be provided to the pilot.
This results in an analysis of equipment that could be exposed to heat from the brake or installation of a brake heat indication system. With regard to safety and cost, locating essential equipment away from possible brake heat is superior to an additional indication system which has its own failure mode and maintenance issues.

In addition to the regulatory differences described above, the FAA and EASA have different advisory material pertaining to 25.729 as follows:

FAA AC 25-22, Certification of Transport Aeroplane Mechanical Systems, dated March 14, 2000. Summaries of the relevant compliance methods are:

25.729(f)(1) The intent is to protect essential equipment from the effects of a tyre burst regardless of the cause of the burst. The preamble to Amendment 25-78 refers to a tyre burst as a sudden, sometimes violent, venting of the pressure from within a tyre. With this in mind equipment in the wheel well is evaluated for its ability to withstand the effects of a bursting tyre and design changes are often made to ensure that a single tyre burst will not cause loss of critical functions.

25.729(e) This paragraph is extracted from an FAA memorandum dated July 12, 1988, which addresses whether a backup gear position indication system is required. The paragraph also contains portions of an FAA memorandum dated June 3, 1983, which addresses whether other regulations need to be considered when finding compliance to 25.729(e). (e.g. 25.1301 and 25.1309)

Landing Gear Slush Tests. While not a specific regulation, this paragraph is extracted from an FAA memorandum dated April 12, 1983, addressing the need for tests to ensure that the landing gear can be extended if joints should become frozen during the flight.

FAA AC 25-7A, Flight Test Guide for Certification of Transport Category Aeroplanes, dated June 3, 1999. Summaries of the relevant compliance methods are:

25.729(d) Flight tests should be conducted to demonstrate the ability of the landing gear and associated components, in their heaviest configuration to properly retract and extend in 1 g flight, normal yaw angles, and airspeeds up to V_{LO} Additionally an engine out gear retraction time demonstration procedure is described.

25.729(e) A combination of flight tests, ground tests, and analysis may be used to show compliance with the intent of 25.729(e)(2) through (e)(4).

EASA AMC 25.729(e) Retracting Mechanism (Acceptable Means of Compliance), discusses 1) the conditions for and colour of light indicators, 2) aural warning with any high lift or engine configurations, 3) avoidance of nuisance activation, 4) inhibition of the warning at appropriate flight phases, 5) means for deactivation by the flight crew. In particular AMC 25.729(e)(1)(b) recommends a warning light consistent with CS 25.1322 (“warning” means a red light) be illuminated at all times except when the landing gear and its door are secured in the landing or retracted position.

EASA AMC 25.729(f) Protection of Equipment on Landing Gear and in Wheel Wells (Acceptable Means of Compliance), discusses 1) exclusion of wheel fuse plugs as complete compliance method, 2) recommendation of a wheel brake temperature warning to the pilot.

The proposed AMC 25.729 Retracting Mechanism (Acceptable Means of Compliance) is based on all those elements.

A number of possible improvements to those texts have been identified by the Mechanical Systems Working Group but felt outside of the initial pure harmonisation effort. They will be considered during the next phase of the harmonisation process after appropriate tasking.

CS 25.773 Pilot Compartment View

The intent of the harmonised rule is to combine the requirements of section 25.773(b) of the Federal Aviation Regulations (FAR), and paragraph 25.773(b) of the Certification Specification (CS), and the advisory material for paragraphs 25.773(b) of the CS into one rule. The rule format is similar to the existing material for CS 25.773(b).
This rule applies to flight deck ice and rain protection systems, specifically flight deck window heat and windshield rain removal systems and their elements.

For the purpose of this rule-

- The flight deck window heat system elements include the front windshields and side windows, electrical control components and the associated wiring and flight deck switches.
- The windshield rain removal system elements include the front windshield wipers, pneumatic air diffuser "jet blast" components, windshield chemical repellent coatings or dispensing components, electrical control components and the associated wiring and flight deck switches.

This rule has been changed to harmonise and clarify CS 25.773(b) and FAR 25.773(b). The current version of sub-paragraph 25.773(b) of the CS is more stringent than §25.773(b) of the FAR by requiring provisions for rain removal during potential system failure conditions. The AC 25.773-1 provides guidance material defining sufficient pilot visibility through the windshield and will be retained with no revisions. The AMC 25.773(b)(1)(ii) does not impose any further restrictions beyond what is already considered in current aeroplane manufacturing design practices. Harmonisation of CS 25.773(b) and FAR 25.773(b) is not affected by the proposed removal of AMC 25.773(b)(1)(ii).

Sub-paragraph (b)(1)(i) of the proposed harmonised rule is written to define the applicable requirements for rain removal systems to provide adequate pilot visibility through the flight deck windshields. The rule defines the worst-case aeroplane flight condition and environmental precipitation conditions which must be considered when demonstrating compliance with the requirement.

Sub-paragraph (b)(1)(ii) of the proposed harmonised rule is written to define the applicable requirements for window heat (i.e. anti-icing) systems to provide adequate visibility through the flight deck windshields. The rule does not specifically address the aeroplane flight or environmental precipitation conditions which must be considered when demonstrating compliance with the requirement. Instead, the rule refers to CS/FAR 25.1419, which provides definition of the icing environment (through further cross-reference to CS/FAR 25 Appendix C continuous maximum and intermittent maximum icing envelopes). Therefore, the specific design parameters to be considered in showing compliance with sub-paragraph (b)(1)(ii) must be sufficiently adequate to meet to CS/FAR 25.1419.

Sub-paragraph (b)(2) of the proposed harmonised rule is written to define the applicable redundancy requirements for rain removal systems. Specifically, this sub-paragraph ensures that the design must have adequate redundancy such that system failures may not cause loss of adequate pilot visibility through the flight deck windshields. The primary implication of this requirement is that windshield wiper (or other mechanical means of rain removal) systems must have separate and independent control switches.

Sub-paragraph (b)(3) of the proposed harmonised rule is written to define the applicable requirements for openable flight deck side windows which must not only be openable, but must also meet the requirements for adequate visibility in the precipitation (i.e. rain) conditions of sub-paragraph (b)(1). In addition, the visibility through the openable side windows must account for "sufficient protection from the elements", which should be interpreted to mean fog on the internal surface of the window. Additionally, ice protection should be considered, unless it is shown that the side window is not subject to external icing.

Sub-paragraph (b)(4) of the proposed harmonised rule is written to define the applicable requirements for alternative means of compliance with the requirement in sub-paragraph (b)(3) for openable flight deck side windows. Specifically, openable side windows may not be required if adequate flight deck window visibility can still be demonstrated even in the event of failures classified as more probable than Extremely Improbable, and also including encounters with severe hail, birds or insects.

Extremely Improbable is defined by the probability of a system failure which would have a catastrophic effect, thereby endangering the continued safe flight and landing of the aircraft by causing loss of life or loss of the aircraft.

In terms of advisory material relative to the CS and FAR standards, the FAA AC 25.773-1 provides extensive definition of what constitutes sufficient pilot visibility through the windshield; therefore, it should be retained but does not need to be revised for harmonisation of CS/FAR 25.773(b). The CS does not have equivalent advisory material. The AC also includes suggested means of compliance for windshield wiper speed. The AMC 25.773(b)(1)(ii), however, includes suggested means of compliance for window heat system performance, which is not covered in the AC but, as stated above, the AMC is not necessarily more stringent than the CS reference to Appendix C and could therefore be eliminated in the harmonised standard.

CS 25.851(b) Built-in Fire Extinguishers

The proposed action is linked to a different EASA/FAA interpretation in the acceptable methods of compliance with CS/FAR 25.851(b)(2) which are to day identical. Technical details are described below.
It has been understood that in order for the FAA to accommodate a more restrictive means of compliance, this interpretation and intent must be introduced in the actual text of the FAR. For the sake of harmonisation, the JAA has accepted to follow that approach. In order to achieve that, it is then proposed a common CS/FAR 25.851(b)(2) change and advisory material (EASA Acceptable Means of Compliance and FAA Advisory Circular) which document acceptable methods for conducting flight tests and/or analyses which can be used for showing compliance to both CS and FAR 25.851(b)(2).

CS 25.851(b) is intended to ensure that the built-in fire extinguishing system does not introduce a hazard to occupants or the aeroplane structure, and that the system is adequate to control any fire likely to occur anywhere within the compartment until an evacuation of the aeroplane can be accomplished. The adequacy of the capacity of the “built-in system” is understood to mean, that there is sufficient quantity of agent to combat the fire anywhere where baggage and cargo is placed within the cargo compartment for the time duration required to land and evacuate the aeroplane.

The key point is that because of the uncertainty in the contents of cargo and baggage placed within a cargo compartment, it must be assumed that each piece of baggage or cargo is a potential fuel source and a potential point of ignition. This is predicated on the basis that all baggage and cargo placed onboard the aeroplane is accomplished in accordance with the EASA approved Aeroplane Weights and Balance Manual. In addition, placement of all baggage and cargo on board the aeroplane must be in accordance with all appropriate national and manufacturer’s loading instructions and limitations.

The FAA acknowledges physical constraints placed upon gaseous fire extinguishing/suppression agents and systems in terms of their molecular density, stratification and the presence of a boundary layer. The FAA position is that no measurements need to be taken within the boundary layer of the cargo compartment ceiling. The intent of this revised rule is not to require extensive data acquisition that extends beyond the current state of the art test equipment capacity. However, FAA accepted means of compliance in the past that allowed the use of averaging of the individual extinguishing agent concentration sensors which resulted in different compliance test success criteria being imposed on applicants for FAR certification as opposed to CS certification. In addition, in the past, for some cases the maximum duration time was calculated by adding a 15 minute allowance for holding and/or approach and landing to the actual time required to reach the alternate landing site under specific operating conditions. Also, FAA accepted means of compliance was limited to data acquisition during flight testing at altitude. With the issuance of this change in CS/FAR 25.851(b) the use of averaged concentration data will no longer be accepted for both FAA and EASA, except in well-defined cases (i.e., during certification tests) where a sensor probe failure occurs and the use of interpolation from adjacent sensor probes is warranted. Compliance with CS 25.851(b) will require the use of point-concentration data from each sensor and that the probes closest to the cargo compartment ceiling must be located at least at the highest level that cargo and baggage can be loaded as specified by the manufacturer and certified by the Agency. Other placement of concentration sensor probes within the cargo compartment should be sufficient to substantiate that there are adequate concentration levels of fire extinguishing agent throughout the compartment to effectively control a cargo compartment fire. In addition, with the issuance of this change in CS 25.851(b) a 15 minute allowance for landing must be included in the diversion time and certification data acquisition must include analytical and/or test data taken after landing at a time increment which represents the completion of an evacuation.

The corroborating factors that led to the harmonised EASA/FAA position include considerations of harmonisation and available test data. Current EASA policy does not accept averaging methods but requires that each individual sensor display the required concentration. In addition, testing at the FAA Technical Center and other data from standardised fire extinguishing evaluation tests indicates that the use of averaging techniques may not substantiate that there are adequate concentration levels of fire extinguishing agent throughout the compartment to effectively suppress a cargo fire. If a cargo fire occurred, and was subsequently suppressed by Halon 1301, the core of the fire could remain hot for a period of time. If the local concentration of Halon 1301 in the vicinity of the fire core dropped below three percent by volume and sufficient oxygen is available, re-ignition could occur. FAA testing and other industry testing has shown that when the Halon 1301 concentration level drops below three percent by volume and the cargo fire re-ignites, the convective stirring caused by the heat of the fire may be insufficient to raise the local concentration of Halon 1301 in the vicinity of the fire.

In addition, as stated earlier, in order for the FAA to accommodate a more restrictive means of compliance this interpretation and intent must be introduced either in the actual text of the FAR or into the preamble of the FAR itself. Thus the FAA has proposed the indicated change in the FAR and associated advisory material which is also proposed for the EASA text.

The proposed change in the regulatory language and in the proposed advisory material must preclude the use of averaging techniques in compliance demonstrations for CS/FAR 25.851(b)(2). The only exception to this will be in the event of a sensor failure where the airworthiness authority may allow interpolation of sensor data during certification testing from other nearby probes to yield an estimate of missing data. AMC 25.851(b) is proposed which will define, in general terms, where gaseous extinguishing agent concentrations should be measured, and how the discrete measured data should be interpreted. Also, the proposed regulatory changes will ensure that means of compliance is sufficient to demonstrate that a “suppressed environment” is maintained in the cargo compartment through landing to enable passengers and crew to evacuate the aeroplane. The proposed AMC will clarify the need to demonstrate compliance upon landing but it will not replace the existing time duration for ETOPS aeroplanes given in JAA IL-20 "Extended Range Operation with Two-Engine Aeroplanes (ETOPS)," which provides acceptable means for approval under JAR-OPS 1.246. In addition, the AMC will include guidance as to when markings and placards are necessary in the cargo compartment to provide sufficient visible reference to enable cargo and baggage loading personnel to ensure that the placement of cargo and baggage is not above the level established by the certification testing.

The additional design/manufacturing costs for these placards and markings are expected to be insignificantly low compared to the aircraft price. When incorporated into the type design, this cost depends on the number of aircraft sold. Also in case of cargo compartment liner replacement during maintenance, or conversion or alteration, the costs for these additional items and installation work is considered insignificant.

It should be remembered that CS/FAR 25.851 provides requirements for built-in fire extinguishing systems regardless of the extinguishing agent or delivery system utilised. Therefore, it is not limited to Halon or gaseous systems. Presently, the EASA has no plan to investigate the suitability of the 5% initial and 3% sustained concentration limits for Halon 1301 gaseous agents systems. Currently industry and the FAA Technical Center are investigating alternate Halon replacement agents and other types of delivery systems extinguishing/suppression systems. It should be noted that the requirements of CS/FAR 25.851 are not limited to Halon 1301 gaseous agents or to any specific agent delivery system provided that such a system is effective in extinguishing/suppressing fire threats in the cargo compartment.

The advisory material will establish criteria for evaluating brief excursions in the concentration readings and if the data from a single measuring point can be time-averaged. Additional laboratory testing is recommended only if critical issues requiring advisory clarification cannot be resolved by other means.

CS 25.1439 Protective Breathing Equipment

The intent of this rule is to combine the requirements of section 25.1439 of the Federal Aviation Regulations (FAR), and paragraph 25.1439 of the Certification Specification (CS), and the advisory material for paragraph 25.1439(b)(5) of the CS into one rule. The rule format is similar to the existing material for FAR 25.1439. This rule applies to design and installation of stationary and portable protective breathing equipment.

The text of the proposed rule incorporates the Acceptable Means of Compliance (paragraphs 1 and 2) and acceptable means of compliance (paragraph 4) of AMC 25.1439(b)(5). The remainder of AMC 25.1439(b)(5) is proposed to be eliminated.

The proposed rule includes the more stringent requirements of FAR 25.1439 and CS 25.1439. Sub-paragraphs (b)(5) and (b)(6) of the existing CS 25.1439 are more stringent than the existing FAR 25.1439. These sub-paragraphs include additional leakage and design requirements above the existing FAR. Sub-paragraph (a) of the existing CS requires protective breathing equipment to be installed for fire fighting use in all compartments accessible in flight, not just specific cargo compartments. Sub-paragraph (a) of the existing FAR 25.1439 requires portable protective breathing equipment for each crew member in isolated compartments; the CS requires the equipment for use of the appropriate crew members.

Sub-paragraph (a) of the proposed harmonised rule is written to define the installation requirements for stationary and portable protective breathing equipment. The rule specifies the areas where protective breathing equipment is required, and differentiates between portable and stationary equipment for the use of the appropriate crew members.

Sub-paragraph (b)(1) of the proposed harmonised rule is written to define the design requirements for protective breathing equipment. This paragraph specifies the requirements to allow the flight crew to continue performing their duties, and to allow other crew members to combat fires. The rule defines the emergency environmental conditions which must be considered when demonstrating compliance to the requirement.

Sub-paragraph (b)(2) of the proposed harmonised rule is written to define design requirements for the mask portion of stationary protective breathing equipment. The rule specifies the protection level that the equipment must provide.

Sub-paragraph (b)(3) of the proposed harmonised rule is written to define design requirements for stationary and portable protective breathing equipment. The rule specifies that stationary equipment for the flight crew must allow communication with other crew members, and must allow usage of radio equipment. The rule also states that portable protective breathing equipment must allow communication with other crew members.

Sub-paragraph (b)(4) of the proposed harmonised rule is written to define design requirements for the eye protection portion of the equipment. The paragraph states that the effects of the equipment on vision must be negligible, with or without corrective eyeglasses being worn.

Sub-paragraph (b)(5) of the proposed harmonised rule is written to define additional design requirements for stationary and portable protective breathing equipment, and to provide Acceptable Means of Compliance. This sub-paragraph specifies performance based requirements for demand and continuous flow systems. Specifically, the rule ensures that the design must have adequate oxygen flow rate, system duration, and leakage limits to protect the crew members, when the equipment is needed.

Sub-paragraph (b)(6) of the proposed harmonised rule is written to define design requirements for protective breathing systems. The rule doesn't specifically address the design parameters, rather it refers to CS 25.1441. CS 25.1441 defines the requirements for the minimum mass flow of supplemental oxygen, standards for oxygen distribution systems and dispensing units, and determining available quantity of oxygen. It also defines the requirements for preventing hazards to other systems due to excessive temperatures, rupture, or leakage.

CS 25.1453 Protection of Oxygen Equipment from Rupture

The CS/FAR 25.1453 define design and installation requirements for built in oxygen systems. An oxygen leak or an oxygen source / tubing location not adequately chosen with respect to the surrounding environment (ambient temperature) and crash landing may create hazardous situations from a fire safety point of view.
Oxygen by itself is stable and non-flammable. However, it does support and accelerate combustion. Once a fire starts, localised oxygen build-up due to a leak could cause adjacent substances to burn more rapidly or even explosively in the presence of combustible like oil, grease etc. .

Therefore, care must be taken to ensure that the test conditions used in certification accurately reflect (or exceed in severity) the environment in which the material is to be used and that operational effects are included in the testing procedures. Elimination of the ignition source, requires controlling temperatures in the system including that of the gas.

Differences between FAR and CS 25.1453 texts are the following :

CS 25.1453 sub-paragraph (a) :
There is no equivalent FAR paragraph. CS 25.1453 (a) require each element of the system to have sufficient strength to withstand the maximum pressures and temperatures in combination with externally applied loads. Demonstration should be done by using proof pressure and ultimate pressure coefficients specified in AMC 25.1453.

FAR 25.1453 Introductory paragraph, sub-paragraphs (a) and (b) / CS sub-paragraph (b) :
CS 25.1453(b) is comparable to the introductory paragraph of FAR 25.1453. CS use the term sources instead of tanks and pipe lines instead of lines.
CS 25.1453(b)(1) is equivalent to FAR 25.1453 (a).
CS 25.1453 (b)(2) is equivalent to FAR 25.1453 (b).

The intent of the proposed harmonised rule is to combine the requirements of section 25.1453 of the Federal Aviation Regulations (FAR), paragraph 25.1453 of the Certification Specification (CS), and the advisory material for paragraphs 25.1453 of the CS into one rule. The design standards have been placed in the text of the rule instead of the advisory material.

This rule applies to built-in oxygen systems and their elements. For the purpose of this rule, the oxygen elements include the oxygen sources, pipe lines, control devices and components from the oxygen source to the oxygen mask.

The merged rule combines the requirements of FAR 25.1453 and CS 25.1453 into one harmonised rule, and eliminate the need for the AMC 25.1453. The harmonisation is accomplished by enveloping (taking the most stringent requirement of) the two rules, and adding all of the Acceptable Means of Compliance from the AMC.

IV. JAA NPA COMMENT-RESPONSE DOCUMENT

DISPOSAL OF COMMENTS

NPA 25DF-316 Cat.1 Items – Mechanical Systems has been developed in the frame of the Harmonisation Work Programme and is sponsored by the Systems D&F Steering Group.

The commented version of the document is draft 3 dated November 14, 2001.
It has been circulated for comments through Central JAA letter ref. 07/03-6-2 02-L062 dated June 1, 2002. End of comment period was September 1, 2002.

Eight organisations have formally replied through the consultation:

Industry
- Airbus, France
- Cessna, USA
- Embraer, Brazil
- AAE Ltd, USA

Authorities
- ACG, Austria
- CAA, UK
- DGAC, France
- SLV, Denmark

Five organisations stated that they either agree or have no comments to offer on the NPA proposal. Three organisations have offered additional comments on the proposal.

The following table describes the comments received and the actions taken by JAA.

Conclusion :

With the exception of modifications to JAR 25.677(b), 25.1439(b)(5), 25.1453(a) and ACJ 25.851(b) §§ 7, 9, 10 and 12, the final JAA text is adopted as proposed in NPA 25DF-316 draft 3 dated 14/11/01.

COMMENT/RESPONSE DOCUMENT ON NPA 25DF-316 DRAFT 3 DATED 14/11/01

No.	From (Organisation)	Affected paragraph	Position	Comment	Response
1	Airbus		Agree		*Noted*
2	Cessna		No comment		*Noted*
3	ACG, Austria		Accept		*Noted*
4	DGAC, France		No comment		*Noted*
5	SLV, Denmark		No comment		*Noted*
6	CAA, UK	JAR 25.677(b)	Propose different text	"… all centre of gravity positions approved … "	*Accepted* *EASA note – Already incorporated in CS-25.*
7	CAA, UK	JAR 25.1439 (b) (5)	Propose different text	Paragraph (b) (5) specifies certain temperature limitations, variously 70°F and 37°C. For consistency, and to agree with normal JAR convention these temperatures should be specified in C(with, if desired, the F conversion following).	*Accepted, using 21°C (70°F) and 37°C (99°F).*
8	CAA, UK	JAR 25.1453	Propose different text	In this text there is inconsistency in the definition of "maximum normal operating pressure". In (a) the text specifies that maximum normal operating pressures includes transients. In (a)(1) it is specified that transient pressures need not be	*First comment is accepted. As worded, (a) and (a)(1) may be interpreted as inconsistent. New wording proposed which introduce the term "working pressure" is retained but a new arrangement is proposed.*

No.	From (Organisation)	Affected paragraph	Position	Comment	Response
				considered except where they exceed the maximum normal operating pressure multiplied by a factor. Thus in (a)(1) the maximum normal operating pressure clearly excludes transients. A second fundamental issue is that (a)(1) allows transient pressures to be ignored when they are below the maximum normal operating pressure multiplied by a factor 1.10. Thus if the maximum normal operating pressure were to be (say) 100hPa, then the transients could be ignored providing they were less than 110 hPa. We think this is an error and the real intent is to exclude transients if they are small (that is less than 10hPa in the example quoted). These problems can be resolved by a change in terminology, and the introduction of the concept of a maximum working pressure(already used in paragraphs d & e) defined as the maximum normal operating pressure, including transients. Using this approach, we propose the following requirement text: (a) Each element of the system, excluding chemical oxygen generators, must have sufficient strength to withstand the maximum working pressures and temperatures in combination with any externally applied load, arising from consideration of limit structural loads that may be acting on that part of the system in service.	*The idea here is to allow transient conditions higher by 10% of the normal operating condition. It has been agreed that a short exposure to higher conditions do no compromise the qualification done against steady states conditions regardless of the level of pressure, if we stay bellow an increase of 10%.* *Proposed new wording:* (*a*) *Each element of the system, excluding chemical oxygen generators, must have sufficient strength to withstand the maximum working pressures and temperatures in combination with any externally applied load, arising from consideration of limit structural loads that may be acting on that part of the system in service.* *(1) The maximum working pressure must*

No.	From (Organisation)	Affected paragraph	Position	Comment	Response
				(1) The maximum working pressure comprises the maximum normal operating pressure, or surge pressures need not be considered if they are less than 10% of the maximum normal operating pressure. The maximum working pressure must include tolerances of any pressure limiting means and possible pressure variations in the normal operating modes. (2) As NPA proposal. (3) Strength demonstration using proof pressure and burst pressure coefficients specified in Table 1 is acceptable, unless higher stresses result when elements are subjected to combined pressure, temperature and structural loads. (i) The proof and burst factors in Table 1 must be applied to maximum working pressure obtained from sub-paragraph (1) with consideration given to the temperature of sub-paragraph (2). (ii) As NPA proposal. (iii) As NPA proposal. Note that in (a)(3) the word "stresses" is introduced in place of "load" since that is more appropriate strength criterion when considering combinations of pressure, temperature and extreme load.	*include the maximum normal operating pressure, the transient and surge pressures, tolerances of any pressure limiting means, and possible pressure variations in the normal operating modes. Transient or surge pressures need not be considered except where these exceed the maximum normal operating pressure multiplied by 1·10.* *(2) Account must be taken of the effects of temperature up to the maximum anticipated temperature to which the system may be subjected.* *(3) Strength demonstration using proof pressure and burst pressure coefficients specified in Table 1 is acceptable, unless higher stresses result when elements are subjected to combined pressure, temperature and structural loads.* *(i) The proof and burst factors in Table 1 must be applied to maximum working pressure obtained from sub-paragraph (a)(1) with consideration given to the temperature of sub-paragraph (a)(2).* *(ii) Proof pressure must be held for a minimum of 2 minutes and must not cause any leakage or permanent distortion.* *(iii) Burst pressure must be held for a minimum of 1 minute and must not cause rupture but some distortion is allowed.* .

No.	From (Organisation)	Affected paragraph	Position	Comment	Response
9	AAE Ltd, USA	ACJ 25.851(b)	General comment	AAE, Ltd. is an industry leader in the market of smoke detection and fire suppression systems (FPS) for aircraft cargo compartments. We have designed, certified and manufactured FPS systems for the cargo compartments of the Boeing 737-200/300/400/500 series (ST01674AT), the Boeing 727-100/200 series (ST01742AT), the McDonnell Douglas DC-9-10/20/30/40/50 Series (ST01455AT), the McDonnell Douglas DC-9-80 series (ST01455AT), the McDonnell Douglas MD-88 Series (ST01455AT), the McDonnell Douglas MD-90-30 series (ST01455AT), the Lockheed L-1011 series (ST02093AT), and most recently, the Airbus A320 series aircraft (ST01077WI). With the exception of the Airbus A320 series, all of these STC's meet the current design requirements and the new operating rule FAR Part 121.313. These designs are metered systems and their duration of protection is based upon the average concentration determined from FAA witnessed flight testing. AAE's FPS design for the A320 series (ST01077WI) meets the "point to point" or upper 10% concentration and duration requirements being proposed by the JAA in the subject NPA. See the attached AAE, Ltd. Product/Service Information Brochure.	*The general concern of this comment regards the applicability of this rule with respect to the existing FAA regulatory structure.* *The NPA text has been developed in harmonisation with the FAA. We expect to see a similar NPRM and then we expect the rule and the Advisory Material to be the same. It is not planned to have this rule retroactive. Therefore, for new design and when the rule will be adopted, it will be applicable for FAA STC. In the meantime, we apply for JAA certification, the TGM/25/09 " Built in Fire Extinguishant Systems extinguishant concentration levels in Class C & D Cargo Compartments" where JAA current interpretation of the requirement 25.851 (b) is clarified. "The fire extinguishant system should provide adequate concentration of extinguishant agent at each location to effectively suppress a cargo fire (e.g. minimum 3% for Halon 1301)."* *This interpretation has already been applied by JAA in recent and current JAA certification and validation projects, applicability to existing design is still under discussion. This TGM is co-ordinated by the Cabin Safety Steering Group (CSSG). In parallel, the CSSG sponsors the NPA 25D-320 & 26B-15 "Revised Standards for Cargo or Baggage Compartments in Transport Category Aeroplanes" which proposes to implement the FAR 25 Amdt. 25-93 into JAR 25 and amendment in JAR 26 is proposed to have it in line with FAR 121 Amdt. 121-269. The NPA 26B-15 may cross link the TGM/25/09 if is decided that the TGM is also applicable to existing design.*

No.	From (Organisation)	Affected paragraph	Position	Comment	Response
				Our European customers are asking us if the existing systems we offer, based upon averaging, will be acceptable to show compliance or if they will have to use systems that meet the "point to point" requirements. Per the JAA-NPA 25D, F-316 Cat. 1 Mechanical Systems dated June 1, 2002 (NPA), we can see that future FPS designs that use the JAR's for their certification basis will have to meet the "Point to Point" system for duration. All of the STC designs mentioned above are currently in use by U.S. and foreign operators. We believe that we have all of the required data to show our averaging designs listed above are compliant with the NPA after minor modifications. We are attempting to assist the operators to show compliance by using our designs as they exist now or using improved FPS designs per the NPA.	
10	AAE Ltd, USA	ACJ 25.851(b)	General comment	Will the operators be able to use an FAA STC based on "averaging" or will they be required to use a "point to point" system?	*See response to comment No 9.*
11	AAE Ltd, USA	ACJ 25.851(b)	General comment	Will "metered" systems be required or preferred versus "dump" systems?	*No consideration of the kind of system used to demonstrate that :* *"The capacity of each required built-in fire extinguishing system must be adequate for any fire likely to occur anywhere in the compartment where*

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					used, considering the volume of the compartment and the ventilation rate" *Any system can be used a priori.*
12	AAE Ltd, USA	ACJ 25.851(b)	General comment	In your opinion, when do you think the JAA will make their recommendation final?	*The ruling will proceed in standard fashion following NPA process.*
13	AAE Ltd, USA	ACJ 25.851(b)	General comment	What type of rule change will the JAA recommend (i.e. an operating rule, an airworthiness directive)?	*See response to comment No 9.*
14	AAE Ltd, USA	ACJ 25.851(b)	General comment	Which operators will be affected and required to comply? For example: in the United States, we have Part 121, Part 125 and Part 129 operators and only FAR Part 121 operators are required to comply with the FAA ruling.	*See response to comment No 9.*
15	AAE Ltd, USA	ACJ 25.851(b)	General comment	When will each CAA adopt the recommendation?	*See response to comment No 12.*
16	AAE Ltd, USA	ACJ 25.851(b)	General comment	If the local CAA's adopt a rule, which operators will be required to comply and in this case, will it be domestic requirements only?	*See response to comment No 9.*
17	AAE Ltd, USA	ACJ 25.851(b)	General comment	Once the rules are adopted, what do you expect the compliance deadline to be?	*See response to comment No 12.*
18	AAE Ltd, USA	ACJ 25.851(b)	General comment	Will the aircraft FPS systems already installed be required to comply with the new requirement? If not, what designs will be acceptable for these FPS systems?	*The FPS systems already installed will not be required to comply with the new requirement as per the NPA 25DF316. The existing design will be acceptable.*

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19	AAE Ltd, USA	ACJ 25.851(b)	General comment	If the operators choose to use one of the FAA STC'd Systems, will the JAA recommend acceptance of the FAA STC's designed to meet the U.S. FAA rule and will the European CAA's also accept it?	*See response to comment No 9.*
20	Embraer, Brazil	ACJ 25.851(b) Section 7 §6	Propose different text	"However, certification data must include analysis and/or data taken after landing at a time increment representative of the completion of an evacuation **of all cabin occupants**" . As proposed in the text above, it is suggested to include a complement to the wording "an evacuation", in order to make clear that it is related to the cabin occupant's evacuation.	*The intent of the comment is accepted. The following more general text is proposed:* *" However, certification data must include analysis and/or data taken after landing at a time increment representative of the completion of an evacuation of all occupants."*
21	CAA, UK	ACJ 25.851(b) Section 9.2 a)	Propose different text	In Section 9.2 reference is made to the FAA approved test plan. This should be the test plan approved by the Authority.	*Accepted*
22	CAA, UK	ACJ 25.851(b) Section 10 §2	Propose different text	In Section 10, reference is made to "Transport Standards Staff and "an issue paper". These references should be "Authority" and "Certification Review Item".	*Accepted*
23	Embraer, Brazil	ACJ 25.851(b) Section 12 §3	Propose different text	" … certification data must include analysis and/or data taken after landing at a time increment which represents the completion of an evacuation **of passengers and crew members**."	*The intent of the comment is accepted. For consistency the text proposed under comment 20 is selected.*
24	Embraer, Brazil	ACJ 25.851(b)	General	"**and certification data must include**	*There is no requirement in terms of after landing*

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		Section 12 §3	comment	**analysis and/or data taken after landing at a time increment which represents the completion of an evacuation**." The bold text above indicated is interpreted as an assumption that analysis or data taken after landing are not required to meet the 3% minimum concentration. The guidance in ACJ 25.851(b) should be more specific about what is the minimum Halon concentration required for the "after landing" condition. In addition, it is expected an explanation on the reasons why such "after landing" data is required.	*Halon concentration. Fire should be maintained to a non hazardous level the time to complete the emergency evacuation and the associated procedures.* *Data are required to assess is the time allowed for the after landing and emergency evacuation is acceptable.*
25	Embraer, Brazil	ACJ 25.851(b) Section 12 §3	General comment	According to the proposed ACJ 25.851(b), no data need be acquired during transient flight phases(climb or descent), because they represent dynamic environment conditions that would preclude accurate data acquisition. It is known that during these transient phases, the ventilation rate and air changes in the compartment will increase a lot and consequently, the Halon concentration will decrease very fast. Being so, there is a feeling that it would not be feasible to achieve a perceptible amount of Halon concentration after landing (i.e. about 3% or more).	*Data should be provided to illustrate the statement "It is known that during these transient phases, the ventilation rate and air changes in the compartment will increase a lot and consequently, the Halon concentration will decrease very fast."* *Assumptions are that the ventilation and air changes are kept to a minimum as in cruise. Halon concentration is not supposed to change during climb or descent. Being heavier than the air, the mass of Halon will move during these phases and this may make the data collected not valid.*